THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE BROADCASTING SITUATION.

THE deadlock which was reached last week in the negotiations between the B.B.C. and the Postmaster-General has stubbornly defied release, and Sir William Joynson-Hicks has adopted the course beloved of politicians who find themselves in a difficulty—he has set up a committee to "inquire" into the matter, on which will fall the responsibility of formulating a definite policy. In the meantime the future of the unlicensed makers of unstamped receivers remains in suspense—but the B.B.C. continues broadcasting and the said makers continue to enjoy the entertainments with which it provides them, free of charge.

It is somewhat amusing, though somewhat pathetic, to observe the unanimity with which the three successive Postmasters-General seek to dissociate themselves from an agreement which they believe to be unpopular; Sir William Joynson-Hicks attributes it, quite rightly, to his "predecessor"; Mr. Neville Chamberlain, who signed the agreement, passes on the responsibility to Mr. Kellaway; and Mr. Kellaway, who really conducted the negotiations and secured the approval of the House of Commons for its terms, throws it back on Mr. Chamberlain, accusing him of "the most startling evasion of official responsibility which modern political practice has produced!" We should have thought that Mr. Kellaway, who switched over from the Post Office to the Marconi Co. and therefore now looks over the other side of the fence, would have been well advised, in his new capacity as a director of one of the chief constituents of the B.B.C., to uphold the agreement rather than to condemn it by repudiating responsibility for its terms—if only for commercial reasons. He really ought to decide, once for all, under which flag he means to fight. But perhaps, under the circumstances, his wisest course would have been to keep silent.

So far as the B.B.C. itself is concerned, it has nothing to fear from the pending inquiry; it will appear at the bar of public opinion as the complainant not the defendant. It should not be forgotten that the remarkable "boom" in the sale and use of radio receivers has been due entirely to the successful operations of the company; concerts and news items were being broadcast from Writtle, Paris, and The Hague, and there were numerous transmissions in operation, to ships, &c., before the company began broadcasting—but there was no market for wireless apparatus, and very few firms were interested in the business. The company had to face the risk of expending capital to no purpose, and rightly claimed safeguards to ensure, if possible, that no loss should be incurred, but it did not look to the licences or royalties for profits—it bound itself, after the payment of a fixed maximum return on the capital expended, to apply any surplus funds to the improvement of the entertainments that it broadcast. So far, therefore, as the broadcasting service was concerned, there was no question of profit—though there might be loss. The real source to which it looked for profit was, of course, the manufacture and sale of receiving sets; but it miscalculated the situation in two respects: on the one hand, it enormously underestimated the magnitude of the boom that came, and its members were not ready to supply a fraction of the demand for radio receiving sets; and on the other, it failed to foresee the extraordinary crop of manufacturers of components of such sets, to which was mainly due the multiplication of unlicensed "listeners-in"

from whom no revenue at all was obtainable. Of the 33,000 applicants for "experimental licences," without doubt the vast majority are of the last-named class, and are wholly devoid of the qualifications for research and investigation which are required of *bona-fide* experimenters; to issue "experimental licences" to these would be an act of gross injustice to the B.B.C., which embraces about 500 British manufacturers—these licences, which confer valuable privileges on the holders, should be strictly reserved for genuine investigators who possess the necessary expert knowledge and technical training to make proper use of the freedom granted to them.

As we have indicated above, the boom in radio apparatus was the direct result of the formation and operations of the B.B.C., which has not, however, secured that share in the business which it expected to get, owing to the evasion of the licensing agreement by innumerable listeners and to the intense competition set up by the many small makers of components; yet it has offered to consent to a modification of the agreement, to enable a new kind of licence to be issued to those who do not buy B.B.C. receiving sets, stipulating only that the licensees shall use parts made by members of the B.B.C. The Postmaster-General is willing to issue such a licence, but subject only to the requirement that the parts used shall be of British manufacture; on this basis the B.B.C. will receive only 5s. per licence, as it can hope for but little revenue from the sale of components. In return for its service, for the excellence of which we can vouch, it will receive less than 1d. a week from each member of its vast audience!—for the number of "listeners-in" is far greater than the number of receiving sets. At present the prospect of its income covering its outgoings in respect of the broadcasting service is decidedly unsatisfactory, but if by good fortune a surplus results, the dividend cannot exceed 7½ per cent. Hence the decision of the Postmaster-General, if carried out, will have the effect of making the B.B.C. a philanthropic institution, existing only for the benefit of the listeners, of the small competing manufacturers, and of the retailers. But it should not be forgotten that the principal member firms of the company are entitled to consideration on the ground that to them we owe the very possibility of broadcasting telephony; huge sums have been spent by them in the development of the valves upon which broadcasting depends, and which can be produced by other makers only as the result of their researches. During the war one of these firms alone made half a million valves for the Government.

We trust that the Committee of Inquiry which has been appointed with the widest terms of reference will approach the matter in a judicial spirit, and that its report will do justice to all concerned, with the minimum of delay.

Plain Words from Sir Robert Hadfield.

Those who appear to be at a loss to understand why large numbers of our industrial and other people are not prepared to return to pre-war trading relations with the German people may find part of the explanation in such speeches as Sir Robert Hadfield delivered at the meeting of Hadfields, Ltd., last week. The experiences which many connected with iron and steel and electrical and engineering industries had of German design and deceit are fixed indelibly upon their minds. The war drove them still deeper home. Matters of such a kind can only be eradicated as unmistakeable evidences are produced of a new Teutonic mentality which shall leave no place for former nauseous practices and shall conform more nearly to British standards of business. It is safe to say that British manufacturers generally—especially in the electrical and engineering fields—are doing little more with Germany than they are compelled by special circumstances arising in exceptional cases. It is recognised that there may be exceptional cases such as, for example, large contracts which can only be secured for British works by including some detail or other of foreign manufacture for which the price is very low or which is unprocurable within these islands and possibly within the Empire. Those who declare that we should repress our antipathies and place orders abroad to help other countries on to their feet must come to recognise that it is our own population's interests and the interests of industrial security for the future that have stood in the way of such a policy and practice. What we recall in regard to the past of the British electrical industry and the methods of German penetration for its undoing here and in the overseas markets, is not unlike the things that occurred to Sir Robert Hadfield when he said last week: "I think that France is perfectly right" (in regard to the Ruhr "adventure," as Mr. Hichens described it), and "In saying this, it is not that I wish for one moment to harm a single German, though I detest them and their ways. After Krupp himself, in the guise of friendship, came round our works as a spy only six weeks before the war broke out, I have never forgiven what I consider to be such horrible and immoral behaviour." We, like Sir Robert, have never minced our words in regard to the detestable past in such connection, and though some may come to regard the preferential Home and Inter-Allied policy as a sort of Ruhr adventure of our own, the attitude is dictated partly because we are determined, like France, that there shall be protection from penetrative and designing attacks on our industrial frontiers. We must safeguard British electrical industry so that it shall grow stronger and stronger, expand its influence as it legitimately should do, and give increasing employment and bread to eat for our unemployed and their families.

The Sixpenny Tax.

Sir Robert Hadfield was equally emphatic in his damnation of the Corporation Profits Tax and his inability to understand why Chancellor Baldwin had not swept away at once and entirely a burden which helped to stifle trade. He holds, as we do, that there is not the slightest excuse for continuing the Tax, and he expressed the hope, in which most business men will join, that the special steps that were being taken by the Federation of British Industries, even at so late an hour, to impress upon business members of Parliament that the industrial and business world disagreed entirely with the decision "to continue the extraction of money out of industry entirely to the detriment of the country itself" would have definite influence. There cannot be any disputing the fact that the entire abandonment of the Tax would have set the blood of industry circulating more freely, hastening the return of health to its entire system—instead of half-hearted sixpenny treatment, which merely moderates the flow of the life-blood from the system, leaving it in weakness so that it shall be still susceptible to the ills which follow exhaustion. In a speech delivered at the annual dinner of the Association of British Chambers of Commerce last week, the Prince of Wales remarked: "Trade recovery is the essential need for us to-day, and the country is looking to the business world to use every endeavour to foster that confidence which is the basis of commercial progress." But the business world cannot put forth its best endeavours while the shackles of taxation (though slightly loosened) still bind its hands and feet.

A Break with Tradition.

"Workmen in the house" has been for a long time a good and sufficient apology for a condition of domestic chaos, until it has become the habit to treat such disorder as a matter of course if the plumber, painter, or electrician is "in."

A laudable effort to alter this state of affairs has been made by a New York electrical contractor, who has set an example which we would desire to see universally followed. According to *Electrical Merchandising*, Mr.

Louis Kalischer desires that his workmen, as well as his materials, shall be beyond reproach. To this end he has ordained that all wiremen employed by him shall wear overalls and cap of spotless white; canvas shoes to avoid the scratching of polished floors; gloves to prevent the soiling of paintwork; and a courteous smile for those with whom they come into contact. They are instructed to cover up with a white cloth anything which may be harmed by their operations, and they are adjured "to be sure to have a clean piece of cheesecloth in the pocket of your jumper," surely the last touch of refinement.

We can foresee that the installation of electrical systems will soon no longer be a cause of trouble and disorder, it will be a pleasure to have such guests in the house!

We can hardly hope that British electrical contractors will go so far to study the convenience of their clients, but, while we may think that the effort is rather overdone, there is ample room for improvement here, an improvement which will certainly do no harm and, very probably, will do much good.

The Electrical Education of the Investor.

There is a good deal to be said in favour of the action of the English Electric Company in circulating with its annual report and financial statement illustrated literature educating its shareholders regarding the nature of its manufacturing operations, the extent and size of its products, and the wide geographical area in which its trading activities are carried on. If we say that a large proportion of the shares in electrical manufacturing and trading companies which are held by the investing public are held by non-electrical people we do not wish to suggest that electrical men have little faith in the electrical industry. As a matter of fact, they are in a position to know better than anybody else how bright is the prospect for that industry, but nobody who knows how to invest puts all of his eggs into one basket or into one industry. Geographical investment is ideal—you at any rate stand a chance of gaining on the swings what you may lose on the roundabouts. Non-electrical investors in taking holdings in electrical companies may know nothing regarding the electrical industry; they may believe that it has a good future, that the yields as shown by the weekly lists are satisfactory compared with many other investments, or may hold shares purely because somebody has put them on to a sure thing. Everything is to be gained, however, by stimulating a greater interest in electrical affairs among such shareholders. A mere brief annual report and balance-sheet vouchsafe information of a meagre and general kind as a rule; the statement of a chairman at the meeting often makes a very interesting story regarding the factors that have affected the year's work, the volume of business in hand, and the outlook, but if these be supplemented by really informative and pictorial matter there may be imparted to the holder of shares a sense of proprietorship in the manufactures that his company produces. Shareholders comprise all kinds of people from those who represent group holdings running sometimes to hundreds of thousands of pounds, and can influence the destiny of large scale contracts, to maiden ladies and small holders who may be influenced to use, and advise others to use, electric cooking appliances, vacuum cleaners, wireless sets, or motor-cars made by Brown & Co., Ltd., "in which I hold a few shares." The sense of shareholding proprietorship and the knowledge of being able to do something to increase the sales of one's own concern is a matter well worthy of attention in businesses both large and small. There is at least one company which holds an enviable record in country house installation work which made a yearly practice of appealing to its shareholders to influence their friends to place orders for such business with the company from which they hoped to continue to draw good dividends. How many men there are in the City who always lunch at one of a particular group of restaurants because they are shareholders in the company owning them, while their wives deal at certain stores and buy particular commodities, &c., for the same reason? The English Electric Company may or may not secure more orders for electric railway work because of the education of its shareholders in regard to the practice and capacity of the company in such a direction, but in other ways it is bound to gain, perhaps in actual orders and perhaps in a better atmosphere on the Stock Exchange. The general good of the industry cannot be harmed, and much benefit may result from the fuller acquaintance of tens of thousands of industrial investors with the part their capital is playing in hastening electrical progress.

Hydro-electric Development in France.

Discussing in a French contemporary the question of "white fuel" in 1922, M. A. Pawlowski refers to the apparent slackening of progress last year owing to a variety of causes. Among other reasons for this state of affairs he points out that the average cost per kilowatt installed, which amounted to 800 or 1,000 fr. in 1913, varied between 2,500 and 3,000 fr. in 1921 and 1922. In addition, credit was restricted and the rate of interest was high, accelerated redemption of expenditure was imposed by the law of 1919, and there was a scarcity of labour. Despite these difficulties, hydro-electric works were in progress last year of a total of 225,000 kW. Applications for concessions of water powers numbered 180 in 1920 and 1921, but only 48 were made last year, although this decline is attributed in part to the extent of the previous applications. The chemical and metallurgical industries, together with the works for railway traction, tend to monopolise two-thirds of the power, the percentage of the energy used for lighting and power purposes having fallen from 50 in 1910 to 40 in 1915 and to 35 per cent. in 1922. As for the calls made upon the capital market by the hydro-electric companies, excluding the railways, it is mentioned that the former applied for subscriptions up to 300 million fr. in 1922, while the average of the three preceding years was 350 millions. Still, the figures for last year are considerable, particularly when it is borne in mind that the total capital invested in water-power undertakings down to the end of 1913 only amounted to 800 million francs.

Cables for 150,000 Volts.

Elsewhere in this issue we publish an article by Major A. M. Taylor, in which the author endeavours to explain more clearly the advantages of the system of cable construction and operation which he recently described before the Institution of Electrical Engineers. The subject is a difficult one, and Major Taylor's system, on the face of it, appears to be complicated; but it can be said with equal truth of other features of electrical work that the diagrams of connections are complicated—for instance, the connections of a main switchboard, or even of a tramway controller—yet in practice they present no serious difficulty. If the complication of the diagrams is the worst charge that can be brought against a system, the criticism carries little weight.

Now, the capital invested in underground transmission lines and distribution cables in this country is not far short of that expended on all the rest of the plant employed in the supply of electricity; and there is no doubt that in the near future it will be considerably increased. The subject is therefore of the very greatest importance to the electrical industry, and whilst we offer no opinion on the merits of Major Taylor's propositions—that is a matter for the cable manufacturers' experts—we are glad to afford him the opportunity to expound them further, and trust that his explanations will receive the fullest consideration from those who are most directly interested. If his claims are well founded, the savings that can be effected may amount to millions of pounds.

WEIGHT REDUCTION IN ROLLING STOCK.

(Communicated.)

The trend of modern practice in the automobile industry is towards a reduction in weight per horse-power, and in the construction of railway rolling stock the reduction of dead-weight is of even more importance, in view of the frequent stopping and the high rates of acceleration which are dealt with. It is obvious that every pound saved in weight involves less energy consumption per passenger-mile, smaller generation and transmission costs, and in fact less generating and transmitting plant. Alternatively, weight reduction enables more passengers to be carried at the same cost.

For the most part these principles are recognised by railway engineers, and in the trial coaches recently

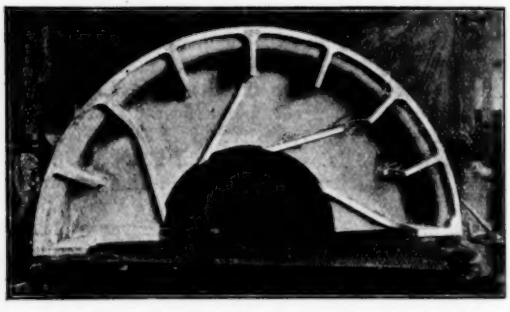

Fig. 1.—Aluminium End-Shield for Locomotive Motor (G.E. Co., U.S.A.).

tested on the London Underground system a greatly extended use of aluminium and aluminium alloys is in evidence. As regards coachwork, the use of aluminium for panelling, roofing, and various internal fittings is well established, and it may be remarked that the weight saved on a 60-ft. railway car by the use of an aluminium roof instead of a steel one is about half a ton, while a further half-ton can be saved by using aluminium for the outside panels. Aluminium sheet is more expensive than steel in first cost, but as the use of aluminium for the roof and panelling alone gives a weight saving about equal to the weight of sixteen passengers, it requires little investigation to show that the extra expense is justified. It is more economical to carry a ton of passengers than an unnecessary ton of dead-weight in metal. Alternatively, if the number of passengers per car is not increased, the use of aluminium instead of steel reduces the running costs by the cost of constantly transporting sixteen non-paying passengers.

Looked at in this way, the real importance of weight reduction is at once apparent, and though much has already been done in this direction, the full possibilities of weight reduction have not yet been explored. Automobile designers have arrived at the conclusion that the most practical way of reducing weight is the extended use of aluminium and its alloys, but in the railway world, designers as a whole have not yet realised that aluminium has an important function as an engineering metal, and can be relied upon as the constructional material for component-parts which are subjected to severe loading or operating conditions. This is particularly the case with regard to the electrical equipment. It may be argued that this is so far standardised that it would be uneconomical, if not impossible, to alter the design; the motors themselves, for example, must conform with very strict limitations as to overall dimensions, but it is nevertheless possible to adopt aluminium for certain important parts without any material alteration in dimensions or design, and thereby obtain a very substantial weight saving.

Before proceeding to indicate the directions in which aluminium would be suitable, it is desirable to point out that an aluminium casting has only about one-third the weight of a casting of the same size in iron, steel, or brass. The strength of the aluminium casting depends very much upon the alloy used, but most of the ordinary aluminium foundry alloys have tensile strengths somewhat higher than cast iron and somewhat lower than cast brass. Much higher tensile strengths are obtainable if necessary by the use of special alloys, but as a rule extra high strengths are not necessary, the thickness of the parts being chiefly determined by the general rigidity of the casting to withstand bending or shocks. In these circumstances it will usually be found that an aluminium casting may be made to exactly the same dimensions as the iron or brass part it is to replace, and, indeed, that the same pattern may be employed provided that suitable allowance is made in the foundry for the different characteristics of the metals.

There will, therefore, be no question that for such parts as resistance frames, contactor boxes and supports, axle covers, and a host of other parts which are not highly stressed, any of the ordinary aluminium alloys will be suitable, and if the question of initial cost is regarded in the light of what has already been said, the substitution of aluminium for these parts will be justified by a reduction of two-thirds of the weight.

An extension of the use of aluminium to the non-magnetic parts of the motors, such as end covers, spiders, &c., involves a serious consideration of the suitability of the metal for withstanding the severe mechanical loading, vibration, and impact shocks to which these parts are submitted in operation. As regards end covers, aluminium has already been used for large locomotive motors, as illustrated in fig. 1, the aluminium casting shown being 9½ ft. in diameter; aluminium end shields have also been in use for some years in the petrol-electric Tilling-Stevens 'buses, as shown in fig. 2. While this type of end shield more

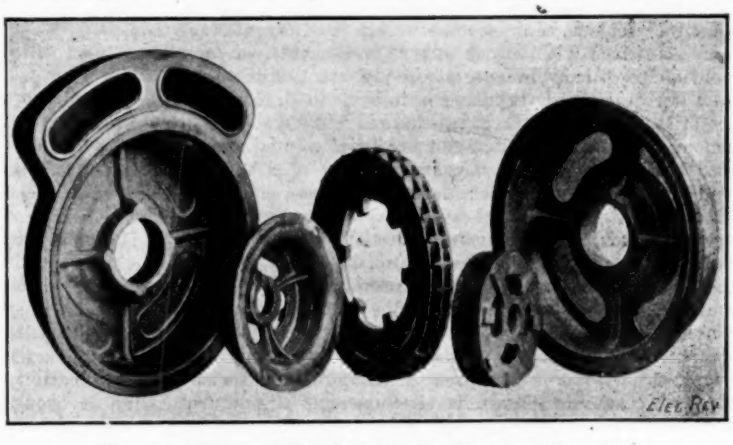

Fig. 2.—Aluminium End-Shields, &c., Used on Tilling-Stevens Road Vehicles (R. W. Coan).

closely approaches the form required for the underslung motors common in this country, in itself this is hardly sufficient to justify extreme optimism as to the suitability of aluminium for the purpose in a railway motor, owing to the very different weights and dimensions. Strong confirmation of the excellence of certain alloys for withstanding impact shocks and high momentary stresses is afforded, however, by some results in a totally different application. For motor lorries, 'buses, and other heavy commercial vehicles, the wheels are usually of cast steel, and following the rapid develop-

ments in aluminium alloys which have taken place during the past few years, it occurred to some enterprising genius to try the daring experiment of substituting for the cast-steel wheel a wheel cast in one of the more recent aluminium alloys. A trial set of these wheels was submitted to the severest possible road tests; a heavily-laden lorry fitted with them was driven over some of the worst roads which could be found in a strenuous attempt to crack the wheels; but the worst pot-holes were negotiated without difficulty, and the aluminium wheels

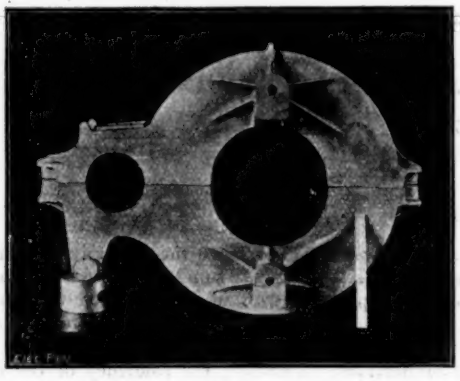

Fig. 3.—Aluminium Gear Case for Railway Motor (W. Mills, Ltd.).

came through the tests without a flaw. Since then extended tests under ordinary conditions have demonstrated that for this purpose aluminium can replace cast steel without sacrifice of reliability, and aluminium wheels are now in regular use on several public services, and have covered long mileages without trouble.

The end shields of an electric motor could hardly be subjected to worse treatment than the wheels of a commercial road vehicle, and it would appear that experiments on the application of aluminium to this purpose would be justified. It may also be mentioned in passing that the use of aluminium for this purpose would tend to minimise flux leakage, an additional advantage which is sometimes by no means unimportant.

Since the chief significance of the use of light alloys lies in the saving of energy absorbed in accelerating the masses up to speed, and since this energy is proportional to the product of mass multiplied by the square of the speed, it will be evident that weight reduction in any of the high-speed parts of the equipment merits the keenest investigation. It would be interesting, for example, to calculate the number of electrical units absorbed in the acceleration of the iron spiders of the armature and commutator at each start. Let this be multiplied by the number of motors on the car, and then by the total number of starts made throughout the year by all the cars on the system, and it will be seen that these parts, though tucked away out of sight, are worthy of serious consideration as a medium for the practical application of the principles of weight reduction. Some modification in the design would probably be necessary, but there is reason to expect that aluminium could be adopted quite satisfactorily for the purpose with a very material weight reduction. A less revolutionary application of aluminium is for the gear cases. Experience has already been obtained with aluminium gear cases, and fig. 3 shows a type supplied for the Southern Railway. The size of these castings is indicated by the foot rule appearing in the photograph, and it may be pointed out that for castings of this type, where the thickness of metal employed is limited principally by foundry considerations, the greater fluidity in casting of certain aluminium alloys enables thinner sections to be used than would be possible with iron, and an additional weight saving results.

Turning now to other parts of the car equipment, the brake system is susceptible to considerable weight reduction. The pump motors should be treated in the manner outlined for the main motors and be fitted with aluminium end shields, &c.; various parts of the pumps themselves may be of aluminium, as also can the valve bodies, and even the piping and unions.

The motor controllers as now made constitute a further example of unnecessarily heavy construction. In this country the top and back castings are often of brass, without any very apparent reason. Aluminium alloys are equally satisfactory, and besides being lighter should be cheaper. Their use for this purpose has recently been tried in America, and fig. 4 shows an aluminium controller back as supplied by the General Electric Co., of Schenectady. Other parts of the controllers, such as the barrel casting, the terminal blocks, the contact fingers, and the handle, are also suitable for manufacture in aluminium.

It is unnecessary to tabulate all the different parts which could satisfactorily be lightened by the adoption of aluminium. When it is appreciated that in alloyed aluminium one has a material which is as strong as iron but is far less brittle, which is very readily machined, and has excellent casting properties, a systematic examination of each single component of the whole train equipment will show that there is a surprising number of parts for which it is entirely suitable.

Finally, it must not be overlooked that aluminium in the pure form is an excellent conductor of electricity, and that a rod of pure aluminium having the same resistance as a rod of copper of the same length will have only half its weight. This provides a further field for weight reduction, and aluminium could be used for the main cables, for contactor connections, and indeed for all conductors where the necessary 28 per cent. increase in diameter will not be a serious disadvantage. The increased section required with aluminium due to its smaller conductivity would not permit of its use for the rotor conductors without a complete redesign of the motors; but this does not apply to the field coils, and it is possible that by taking advantage of the insulating

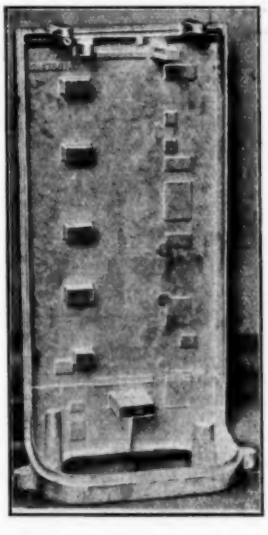

Fig. 4.—Aluminium Controller Frame (G.E. Co., U.S.A.).

properties of aluminium oxide, aluminium field coils might be adopted without any alteration in the frame size. Coils made of aluminium wire, with no other insulation between turns than a microscopically thin film of oxide on the surface of the wire, have been in use for many years for lifting-magnets, and have also been adopted to some extent for tramway motor field coils. The oxide film, which is formed on the wire by a simple chemical process, is an insulator of a very high order, and it has the advantages that it is totally unaffected by heat or moisture, and that it takes up no measurable volume. It has been found that, using square oxide-insulated aluminium wire as an alternative to round cotton-insulated copper wire, an aluminium coil having the same resistance and number of turns as a copper coil

will have the same dimensions but will have only half the weight. On the other hand, a coil wound with square copper wire would certainly be smaller than the equivalent aluminium coil, and in these circumstances it might not be possible to fit an aluminium coil into the space available unless advantage were taken of the heat-resisting qualities of the oxide insulation, allowing a higher temperature rise for the aluminium coil, with a higher resistance and smaller aluminium section.

It must not be overlooked that as an electrical conductor aluminium is intrinsically cheaper than copper, and in electrical applications weight saving is obtained with a reduction in capital expenditure. When, as now appears to be the case, the substitution of aluminium for cast iron is justified by the weight reduction in spite of the higher cost, the particular advantage of substituting aluminium for copper wherever possible needs no further emphasis.

LARGE TURBO-ALTERNATORS AT GENNEVILLIERS.

The 40,000-kW Alternators of the Société Alsacienne.

(*Concluded from p.* 606.)

The no-load and short-circuit characteristics are shown in fig. 7. It is to be noticed that the short-circuit characteristic does not pass through the origin; this is due to the presence of the slot-bridges which close the leakage slots and which, for a very small excitation, form a magnetic short-circuit for the flux due to the field, eliminating all mutual induction between the field and armature.

The excitation necessary to produce the normal current of 4,200 A on permanent short circuit is 272 A, represented by cc'. The quantity of air circulating in the alternator was measured and found to be about 49 cubic metres per second.

After the preliminary tests, the machine was put into service without incident, and was subjected to tests on load, heating and efficiency tests, which were carried out simultaneously. The efficiency was found by determining the losses shown by the heating of the circulating air. The machine was first put on no-load, without

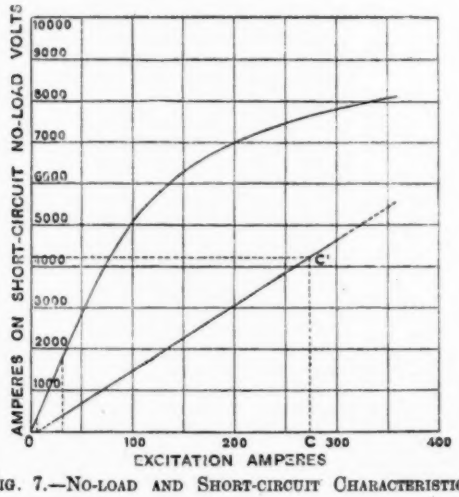

Fig. 7.—No-load and Short-circuit Characteristics.

excitation, the heating of the air in this case enabling the ventilation and windage losses to be calculated (=480 kW). Another test, the machine being excited to normal voltage, gave the iron losses (=420 kW). The heating of the air on load enabled the efficiency and supplementary losses to be directly fixed by the difference of the losses determined in the first tests and of the ohmic losses in the copper of the field and armature.

The results are tabulated in Table I (condensed). The resistance of the armature, per phase, when hot may be taken as equal to 0.0014 ohm and that of the field as 0.48 ohm. The efficiency is thus found to be 96.9 per cent. with a load of 40,000 kW, p.f. 0.9, and normal pressure 6,000 V. Included in this value of the efficiency are the real losses in the stator iron, which are not those measured at the same voltage on no load, but those corresponding to the real flux in the core, included in which flux is that necessary to compensate for the inductive drop arising from the leakage in the end-connections. Further, the efficiency of the exciter and the supplementary losses have been taken into consideration.

Table I.

Test No.	I.	V.	VIII.
Nature of Test.	On Short Circuit.	On Load.	
Pressure, V ...	—	5,400	5,820
Current, A ...	4,800	4,200	5,000
Load kW ...	—	26,500	32,800
kVA ...	—	39,300	50,200
Power factor ...	—	0.70	0.65
Exciting current, A	310	430	545
Increase of temperature of air, °C.	20.4	22.1	27.2
Corresponding losses, kW ...	1,100	1,190	1,460

The heating tests were generally made on one generator working in parallel with one or two of the others; the machine undergoing the test was overexcited to give a current loading, which explains the small power factors; these do not in any way represent that of the busbars.

It is generally conceded that the short-circuit test enables the stray load losses to be estimated, by subtracting from the total losses on short circuit, the constant bearing and windage losses and the ohmic armature and field losses. For normal machines this method is sufficiently exact, but the test results in Table I clearly show that this method is completely inapplicable where machines with a high armature reaction are concerned.

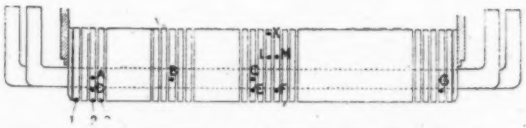

Fig. 8.—Arrangement of Couples (see also Fig. 5).

Comparing the short-circuit test with Test No. V, for example, the total losses are not appreciably different in the two cases. In the short-circuit test the iron-losses are very low, and the excitation losses considerably lower than those on load; the difference arises from the stray load losses which exist on short circuit, but which almost entirely disappear on load, and which are, to a great extent, due to the parasitic flux.

The supplementary losses on load were determined by the differential method which has been mentioned above; they are very small, being, for the normal current of 4,200 A, of the order of only 90-100 kW, whereas, determined by the short-circuit test, they would be 460 kW.

The heating of the field was determined by measurement of the increase of the resistance, and that of the

stator by thermo-couples. A large number of these were distributed in all parts of the stator, the majority being put in during construction; there are couples in the body of the laminations, both in the stator core and in the teeth, which were put in position during the building-up of the core. Two couples were even embedded right in the copper, inside the wrapping, in the middle of the bars; the precaution of using the bars connected directly to the neutral point was taken, to avoid all danger during reading. There are usually two couples together, the second being used as a spare in case of cutting. The positions of the couples are shown in figs. 5 and 8.

Table II shows the results of the measurements made by means of the couples. Those right in the copper show the maximum heating to which the insulation is subjected. The small heating of the copper indicates that these machines could easily withstand a continuous load of 55,000 kVA.

Test No. VIII is particularly remarkable, since it represents a current overload of about 20 per cent. and a kVA overload of 15 per cent.

An important conclusion must be drawn from a comparison of the readings of couples 10 and 12 (fig. 5), the former being in the bottom conductor and the latter in the upper one in the same slot. It is noticed that the heating, measured by these couples, is practically the same in the two conductors. But it is recognised that the stray losses due to eddy currents are, in badly-designed bars, very much greater in the upper conductor of a slot than in the lower.

Table II.

Test No.		I.	II.	III.	V.	VIII.
Position and indication of the couples.		Short-circuit. Unexcited. No load. Increase of temperature above the temperature of the intake air. (Degrees centigrade).				
Core	M	25	7	39	44	52
,, ...	L	18	4.8	31.5	34	34.5
,, ...	K	17	6	30.5	29.5	31
Teeth	G	70	9	24	56.5	60.5
,, ...	D	44	10	22	38	46.5
,, ...	F	27	8	26	34.5	36.5
,, ...	E	26	8	23	30.5	29.5
Slot-bridges ...	I	74	13	22	48.5	—
,, ...	2	41	14	23.5	40.5	—
,, ...	3	35	13	24	34.5	—
Between wrappings ...	A	47	9	20.5	37.5	46.5
	B	32	10	26	31.5	40.5
	C	27	9	23	25.5	27.5
On the copper ...	10	40	12	26.5	32.5	37.5
In the slot ...	12	41	12	27.5	33.5	37.5

The fact that the measured heating of the two conductors is equal enables the conclusion to be formed that in the type of bar employed the supplementary losses due to eddy currents are completely eliminated. Similarly, the diminution of heating in the outermost core-packets on load is confirmed. The almost uniform value of the heating during test No. III along the whole length of the stator shows the efficiency of the ventilating system used; the temperatures are practically the same at the centre of the machine as at the extremities.

The heating of the rotor, carrying 470 A, was 47 deg. C. In every case the heating on load was very much below the guaranteed figures.

The total inductive drop to be considered for the calculation of the instantaneous short-circuit current is made up as follows:—Leakage slots, 10.2 per cent.; normal slots, 2.8 per cent.; end-connections, 9.5 per cent.; slot-bridges, 1.5 per cent. Total, 24 per cent.

The inductive drop of 24 per cent. corresponds to an instantaneous symmetrical short-circuit current of $100/24=4.17$ times the normal current, the field leakage not being taken into account.

The oscillogram, fig. 9, shows that the curve of short-circuit current is not perfectly sinusoidal; it has a very pronounced straightening-out in the no-current region, and there are two others, less marked, at 60 deg. from this position, which correspond to the instants when the current is zero in one or other of the two other phases. This phenomenon is due to the slot-bridges, and reproduces, at each alternation, that which the short-circuit characteristic shows for small excitation currents. When the current is zero in one phase, and remains zero during a certain time, the currents in the two other phases cannot vary either, for they have to be equal and of opposite sign; this explains the "flattening-out" at 60 deg.

The field curves on no load are given in figs. 10 and 11; they were taken by means of a turn next to the winding, when the machine was not saturated (fig. 10, taken at 2,400 volts), and when the machine was saturated (fig. 11, taken at 7,000 volts). It is seen that, owing to the saturation of the rotor teeth, the last curve closely resembles a sine wave. The curve at normal voltage is perfectly sinusoidal, without the slightest tooth-ripple, so that it is useless to reproduce it.

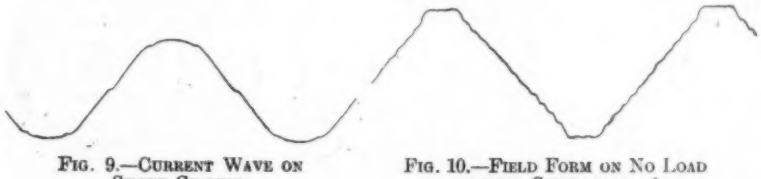

Fig. 9.—Current Wave on Short Circuit.

Fig. 10.—Field Form on No Load below Saturation.

Fig. 11.—Field Form on No Load with Normal Saturation.

It is claimed that the experiments made on the Gennevilliers machines show that they amply fulfil all the conditions demanded of them; the studies and tests made on these machines indicate that, in the future, it will be possible to embark, with success, upon the construction of the largest alternators that may be required.

Readers who desire to consult a more detailed account of the machines and tests are referred to our contemporary, *La Revue Générale de l'Electricité* of February 24th and March 3rd, 1923.

Factory Lighting.—Two papers on the important subject of factory lighting were read at a meeting of the National Council of the Pottery Industry at Stoke, on April 12th. The first paper was by Mr. D. R. Wilson, M.A. (H.M. Inspector of Factories and a member of the Home Office Departmental Committee on Lighting in Factories and Workshops) on "The General Principles and Practice of Industrial Lighting." He devoted most of his remarks to the subject of glare, but pointed out that inasmuch as half the possible light might easily be lost through dirty globes and worn-out gas mantles, &c., it was in the interests of economy that these should be periodically cleaned and replaced. Since the sources and decorations obviously could not be kept in their original state of efficiency, allowance for deterioration should be made in planning any system to attain a given standard. If there was generally little fault to be found with adequacy, the same could not be said of suitability, and 90 per cent. of factories were capable of more or less improvement in this respect.

The second paper was by Mr. E. A. R. Werner, O.B.E., B.A. (H.M. Superintending Inspector of Factories), who spoke with special reference to the particular requirements of pottery processes. He explained that a point that needed consideration was the position of the workers in relation to the sources of light. With regard to artificial light for most pottery processes a point overhead and a short distance half-right of the worker appeared to be generally suitable. The necessity for screening or shading seemed to have been completely overlooked, and the usual way of meeting the double need of local and general illumination in a pottery appeared to him to be unsound—the lights were raised several feet too high over the benches and the shades flattened and spread out to such an extent as to render them useless as screens. Moreover, this most common system of artificial lighting was decidedly the reverse of economical.—*Stafford Sentinel.*

UNDERGROUND CABLES AT 150,000 VOLTS.

By MAJOR A. M. TAYLOR, M.I.E.E., Mem.Am.I.E.E.

It has been represented to the writer by several well-known engineers that a more complete statement as to what really constitutes the special features of his system of transmission, as to how it is carried out, and how the parts operate during the transmission of power, would be welcomed; and he therefore will endeavour in the present article to supply this deficiency.

On account of limitation of space, it will have to be assumed that all readers of this article either have copies of the *Journal* of the I.E.E. containing the paper read in London on December 7th, 1922 (*Journal*, Part 315, p. 245), and the discussions, or have access to them.

Intersheaths.

The principal features of the "hexaphase" system are:—

(1) The employment of "intersheaths" for transmission of *power*, as distinct from transmission of *potential*, thereby securing the employment of conductors sufficiently heavy to avoid their being burnt out by a short circuit occuring between intersheaths at any part of the line, and at the same time permitting the capital outlay on the said intersheaths to be debited to the transmission of saleable power rather than to the carrying of useless capacity currents.

The gain in voltage that can be applied to a (single-core) cable having a given total thickness of insulation is shown by Table II, on page 15 of the author's paper (I.E.E.), to be approximately 50 *per cent.* (See also the early part of his reply to the London discussion, *Journal*, Part 315, p. 245.) The author's Table III represents a further stage of development, and involves a *further gain of* 30/35 *per cent.* (*i.e.*, a 95/100 per cent. total advantage). The exceedingly valuable proposals made by Mr. Ll. B. Atkinson and Mr. C. J. Beaver in 1914 considered the employment of intersheaths only to the extent that the maximum potential gradient was kept *constant* on successive intersheaths. In the author's Table III, however, the reducing of the maximum voltage gradients at the central core, and the increasing of those at the outer cores, is shown to be unaccompanied by any rapid increase in the loss in the dielectric—in fact, the extra loss is only 4 per cent., while the gain in voltage is, as stated, roughly an additional 30/35 per cent. (The point to be noted is that it is obviously desirable to work those parts of the dielectric which are situated near the coolest intersheaths at the highest dielectric stresses, provided we can thereby secure a gain in voltage without material extra dielectric loss.)

(1A) The abandonment of 3-phase cables in favour of 1-phase cables is another incidental feature of the employment of intersheaths. It becomes impossible to find room, in an ordinary 3-phase cable, for intersheaths, if they are to be properly applied. Hence, single-phase cables become essential. But if we take a single-phase cable and apply intersheaths, we still have a very considerable reduction of diameter over that of a 3-phase cable. This difference in diameter can be effectively employed in adding further intersheaths, and so taking up, say, another 50 per cent. (or greater) increase in voltage, the result being that the voltage which can be applied is 193 per cent. higher ($1.5 \times 1.3 \times 1.5 = 2.93$) than in the original 3-phase cable (*i.e.*, it is 2.93 times as great). Consequently, where only 50,000 volts was previously possible, approximately 150,000 volts becomes possible—not to mention other very important gains due to only one-third the amount of heat being generated in a single cable (see *Journal*, Part 315, page 245).

It is also worth pointing out that an "intersheathed" cable can be worked at 95 per cent. greater voltage than a *single*-core non-intersheathed cable for a given thickness of insulation. It can also carry a greater current without overheating.

The successive gains effected by the above suggestions may perhaps be better appreciated by a concrete example.

Referring to figs. 1, 2, 3, and 4 below:—

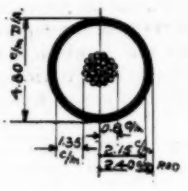

Fig. 1.—Gennevilliers Cable.

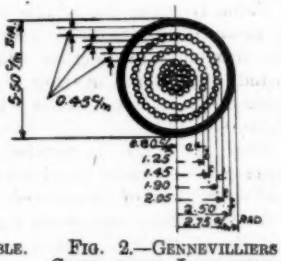

Fig. 2.—Gennevilliers Cable with Intersheaths.

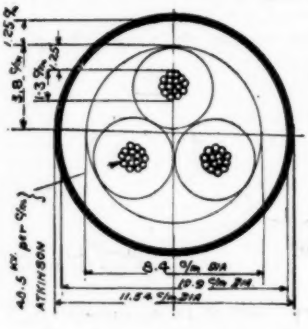

Fig. 3.—Standard 3-phase Cable.

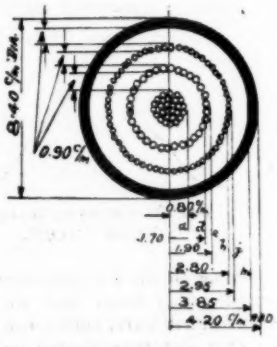

Fig. 4.—Increased Insulation over Fig. 2.

Fig. 1 represents the Gennevilliers cable (of 0.25 sq. in. cross section), which works at 60,000 volts (between lines), or 35,000 volts per phase, and on which the author figures the maximum potential gradient at 44 kilovolts per cm.

Fig. 2 represents the insulation divided up into three portions, or concentric slices, and with two "intersheaths" introduced, which, of course, slightly increases the overall diameter of the cable. Fixing the maximum potential gradient at 44 kV/cm. as before, and repeating it on all the intersheaths, the voltage absorbed per cable is now—

$$15{,}700+17{,}300+17{,}800=50{,}800 \text{ volts.}$$

That is, for equal thickness of insulation, the voltage is raised from 35,000 volts (per phase) to 50,800 volts, *viz.*, 1.45 times. This checks very interestingly with the author's Table II (I.E.E. paper), where the value 1.47 was obtained as the advantage realised over Table I (in which a cable *without* intersheaths was taken as the starting point).

In fig. 3 we have a standard 3-core cable, intended to work at 55,000 volts, under a maximum potential gradient of 44 kV/cm., but having only 0.15 sq. in. copper cross section (it being impracticable to put in more copper without exceeding the predetermined maximum potential gradient). The diameter under the lead sheath is 10.9 cm. The corresponding diameter of the Gennevilliers cable, with intersheaths, is 5.0 cm. There is obviously nothing (save preventible mechanical troubles) to hinder our doubling the diameter of the "intersheathed" Gennevilliers cable, thereby greatly increasing the voltage that can be applied.

In fig. 4 the intersheaths of the Gennevilliers cable have been redistributed so as to utilise uniformly the

suggested increased depth of the insulating material; *but the full difference of diameter between fig. 2 and fig. 3 has by no means been drawn upon*, as will be immediately evident by inspection. Nevertheless, working to the same limiting potential gradients as before (44 kV/cm.), we can now absorb 26,600 + 32,250 + 34,600 = 93,450 volts, corresponding with a voltage between lines of 161,000 V.

It should particularly be noted that *the above result is obtained without drawing at all upon the gain shown by the author in his Table III* (I.E.E. paper) over that given in Table II. Had this been done, the voltage of transmission could no doubt have been raised to over 200,000 volts.

Neither, again, is the fact taken account of that the thermal gradient of the No. 4 cable is very much lower than that of No. 3, due to the I^2R losses of *three* phases being liberated in No. 3 as against the losses of *one* phase in the other cable. This point has been gone into in the author's reply to the London discussion (*Journal*, Part 315, p. 245).

Lastly, had the diameter of the cable in fig. 4 been increased fully to that of fig. 3, it is probable that *for equal core temperatures* the voltage of transmission could have been raised to five times that of fig. 3, *i.e.*, to something of the order of 260,000 volts.

(This, of course, is ignoring the question of capacity current, for dealing with which the author has special proposals.)

Capacity Current.

Taking 150,000 volts for the single-core cable (*i.e.*, neglecting gains under Table III of the I.E.E. paper), and 50,000 volts for the 3-core non-concentric cable, and following the lines of the author's reply to the London discussion on his paper (*Journal*, Part 315, p. 245), it will be found that, for equal temperatures of core, twelve 3-phase cables are necessary to do the work of four 0.28-sq. in. 1-core cables, *viz.*, 75,000 kilowatts. (The author has recently found means of doing with four cables the work for which he previously postulated six cables.)

If the kVA of wattless power be now worked out for the two systems, it will be found that, in a 30-mile 75,000-kilowatt transmission line, the:

Wattless kVA of 12 cables, each of 0.15 sq. in. per core (50,000 V)=71,500 kVA.

Wattless kVA of four cables, each of, say, 0.30 sq. in. aggregate, as per fig. 4 above (150,000 V)=87,000 kVA.

Allow in each the same dielectric power factor (on account of hysteresis only), *viz.*, 0.015 (since both are under the same dielectric stress), and the dielectric hysteresis losses then become—

kVA loss with 12 cables (50,000 V)=1,070 kVA.

kVA loss with 12 cables (50,000 V)=1,070 kVA;

And the dielectric hysteresis losses, expressed as a percentage of the total power are—

% kW loss with 12 cables (50,000 V)=1.43%

% kW loss with 4 cables (150,000 V)=1.74%

That is, there is a difference of only 0.31 per cent. between the two systems at 75,000 kilowatts transmitted. The hexaphase system, as per fig. 4, is, however, designed to transmit 112,000 kW; and for only a comparatively small increase in the capacity current it would, if redesigned, transmit 220,000 kW. The percentage dielectric loss at 112,000 kW would be only 1.15 per cent.; while with the (18) 3-phase cables it would be 2.15 per cent.—a clear *saving* of 1 per cent. in *favour* of intersheaths. The percentage loss at 220,000 kW would probably be only 0.75 per cent. It is thus clear that, when we come to large powers, dielectric hysteresis loss becomes unimportant.

The methods by which the author proposes to transmit and distribute capacity current are perhaps sufficiently described by figs. 12 and 15 of the I.E.E. paper; as to the former of which, it is sufficient to say that, by its means, capacity current (even for the outer intersheaths) can be transmitted at 150,000 volts and distributed back from the sub-station, or sub-stations, at the voltages which have to obtain between intersheath and intersheath, and as to fig. 15, it may be said that this method of feeding the capacity currents would altogether avoid the necessity of transmitting them over the central core, or intersheaths, and thus leave the whole of the copper of the cable virtually free to carry the load currents, with consequent great advantage to the whole system from the point of view of regulation, besides rendering the arrangements of fig. 12 unnecessary, on long lines.

The above remarks (with the exception of the last paragraph) may be considered as treating of the possibilities of an ideal "intersheath" system. The author's hexaphase system, as modified since the reading of his I.E.E. paper, comes within 15 per cent. of that ideal and the other advantages—not drawn upon in the calculation just presented—will amply compensate for this deficiency.

It will be understood that, except for the transmission of *power* through the intersheaths, the arrangement shown in fig. 5 of the I.E.E. paper is as good as the author's, though it has the added imperfection of not offering a solution for the transmission of capacity currents over great distances without enormous copper outlay on the "intersheaths."

It ought, however, to be pointed out that the transmission of *power* through the intersheaths affords the equivalent of reducing the thermal resistance of the cable, and hence of cooling the innermost conductor, which is all a step in the right direction.

(To be concluded.)

LEGAL.

Blackpool Corporation Sued.

On April 18th Mr. Douglas Cooke, a taxi-cab proprietor, sued the Blackpool Corporation for damages to the extent of £98 for personal injuries and damage to his car.

It was stated by counsel for the plaintiff that at Christmas Mr. Cooke was driving a party of five in his taxi-cab when a live overhead trolley wire fell, smashing the windscreen of the car, cutting plaintiff's face, and damaging the car. It was some time before the wire could be removed to permit the occupants of the car to leave it. The Corporation denied that negligence had been proved, but the judge held otherwise, and awarded plaintiff £53 with costs.

Palmer v. General Electric Co., Ltd.

Defendants were sued before Mr. Justice Darling and a special jury in the King's Bench Division on April 18th by Mr. A. E. Palmer, Mrs. Palmer (his wife), and their seven-year-old boy, of Devonport Road, Shepherd's Bush, who claimed damages for personal injuries and loss sustained in a collision which, they alleged, was due to negligent driving by a motor car driver in the defendant company's employ. Defendants denied any negligence.

It appears that on August 14th last year Mr. Palmer was riding his motor-cycle, with his wife and child in a sidecar, on the return journey from Watford to London. Defendants' motor-car was proceeding in the opposite direction. Immediately in front of it there was a cyclist who fell from his bicycle, and in order to avoid him it was said that the motor-car turned towards the centre of the road and came into collision with Mr. Palmer's motor-cycle. The motor-cycle was damaged beyond repair, Mr. Palmer's leg was injured and had to be amputated below the knee, Mrs. Palmer was shaken, cut and bruised, and the boy's leg was broken. Consequent upon his injury Mr. Palmer had lost his employment as a milkman.

The jury disagreed and were discharged without giving a verdict.

Unlicensed South African Electrician Fined.

Our South African correspondent states that at the Cape Town Criminal Court recently, Frank Scullard, a European, was charged with contravening the municipal regulations for the licensing of electricians by carrying out wiring work at premises connected with the municipal power station without being in possession of the necessary licence. An installation inspector said the work was not done in accordance with the regulations, and in one instance two flexibles were taken from one ceiling rose. Accused, who admitted a previous conviction under the Electric Lighting Act, in 1921, was fined £2.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Small Geared Motors for Low Speeds.

Messrs. Marryat & Place, 28, Hatton Garden, E.C.1, have produced a range of small, self-contained, geared motors for the driving of individual machines. The illustration (fig. 1) shows one of these, which has been installed at a London stationery works to drive a ruling machine. This consists of a ¼-h.p. motor with a self-contained reduction gear, which

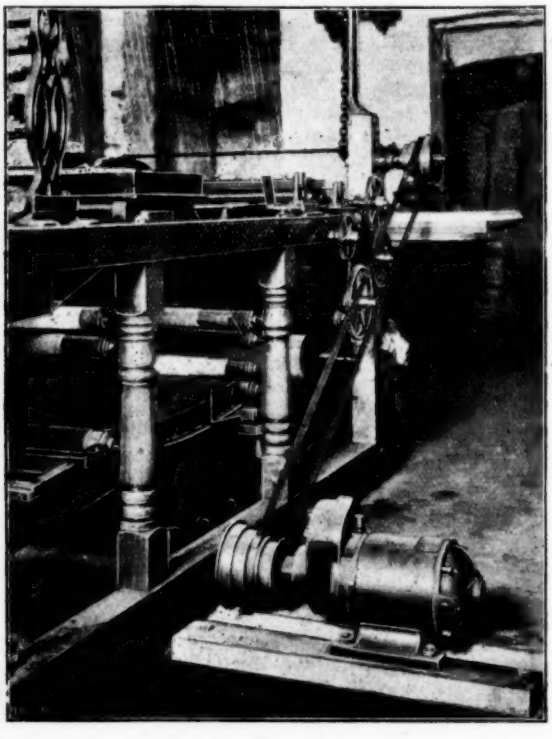

Fig. 1.—A Small Geared Motor Driving a Slow-speed Machine.

steps down the speed to 80 r.p.m.. Four-step cone pulleys and a speed controller are fitted. This arrangement gives an almost infinitely variable speed ratio over a wide range.

These motors are made in the following sizes: 1/16, ⅛, ¼, ½, and 1 h.p., the diameter of the casing ranging from 4½ in. to 11 in., and the overall length from 11¼ in. to 30 in.

The "Universal" Brush Holder.

Messrs. G. and J. Paton, 160, Hope Street, Glasgow, have designed a brush holder, the principal features of which can be seen from the illustration (fig. 2). The holder and adapter

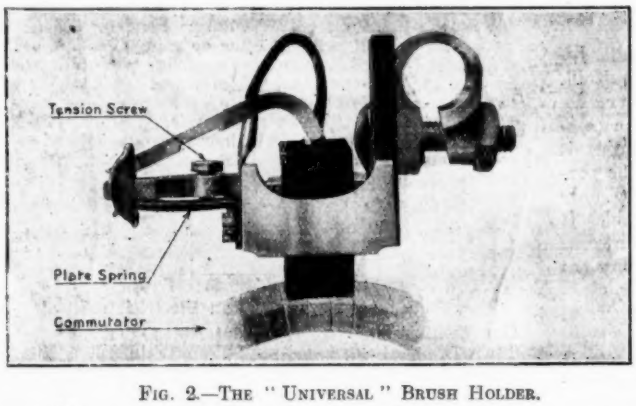

Fig. 2.—The "Universal" Brush Holder.

are made from a solid brass casting, and are of substantial proportions. The spring is of the steel-plate type, which does not possess the inherent weaknesses of clock-type springs. The pressure arm is mounted on knife edges, ensuring "liveliness" and increased efficiency. The brush box has ends which are self-aligning to the radius of the pressure arm, allowing the brush to be at all times in contact with the holder, and preventing the brushes becoming jammed with dirt collecting between the ends of the box and the brush. Commutator wear and variation of the distance between the commutator surface and the brush holder spindle on different types of machine is easily compensated for by moving the spindle adapter. A screw is provided for varying the tension on the spring. The brush can be removed for examination by lifting up the pressure arm, which is made to stay in the "off" position when raised to its full extent. This allows the brush to be removed with one hand. The holder may be removed entirely by loosening a substantial nut on the adapter. The holder is made to suit all normal sizes of brush, and is adaptable to all sizes of spindle. No special shape of spindle is necessary

A Commutator Slotter.

The Martindale Electric Co., of Cleveland, Ohio, has put on the market the "Imperial Undercutter," which is a new device for slotting commutators. The appliance, shown in fig. 3, is driven through a flexible shaft from an electric drill, and may be purchased with or without the motor, as desired. The cutter sets in a recessed portion of the tool and "V"-shaped milling cutters are used instead of the usual square-toothed saw. This produces a "V"-shaped slot, which is recommended as being self-cleaning, and also avoids the necessity for scraping the strips of mica from along the edges of the commutator bars. A movable block with a guide for riding in the adjacent slot is provided at the left of the cutter, and a micrometer screw adjustment on the shaft of the cutter enables one to locate the cutter in the exact centre of the mica. There is also an adjustable "V"-shaped rest for regulating the depth of the slot and to insure uniformity.

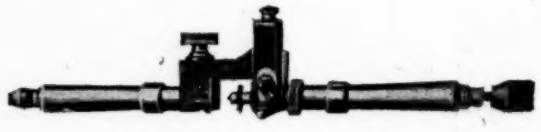

Fig. 3.—A New Commutator Slotter.

The handle shown at the left in the illustration is hollow, so as to permit the attachment of compressed air lines to blow away the dust from the front of the cutter and thus to enable the operator to see his work clearly at all times.—*Electric Railway Journal.*

A One-piece Rotor.

The *Scientific American* recently noted an effort to avoid the trouble caused by the loosening of rotor bars, which often occurs in squirrel-cage motors. This is effected by the construction illustrated in fig. 4. The entire winding consists of a single sheet of copper punched and formed by a special mechanical process. This one-piece winding is machine-wrapped round the rotor core, the copper bars being expanded into the core slots by swaging. The single joint, which extends through the two end rings, is silver-soldered, after which the metal at both connections is re-hardened at the points softened by the welding heat. The rotor winding, except for the joint in the two end rings, is electrically and mechanically just as sound as a piece of copper pipe. The rotor core is a self-contained unit, and having a straight keyway, may be pressed on and off the shaft. The motors embodying this new device are made in the standard industrial sizes, voltages, and frequencies.

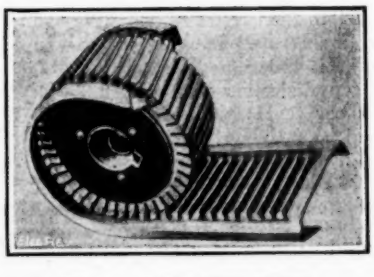

Fig. 4.—A One-Piece Rotor.

PARLIAMENTARY NOTES.

[By Our Special Parliamentary Reporter.]

Spark Radio Stations.—On April 17th, Lt.-Col. Moore-Brabazon asked the Postmaster-General when he proposed to abolish spark stations of high-power coming under the Post Office.

Sir W. Joynson-Hicks said so long as spark reception was generally employed by ships, and was in harmony with the International Radiotelegraph Regulations, it was not practicable to abolish that system at the Post Office coast stations. These stations, however, were not high-power stations. The power varied from 1½ to 5 kilowatts, with the exception of a station of 10 kilowatts in South-West Ireland.

New Pacific Cable.—On April 17th, Commander Bellairs asked what was the route of the new Pacific cable; in what way it would be linked with the American cable to Honolulu; and when it was to be put in hand.

Sir W. Joynson-Hicks said the Pacific Cable Board was now laying new cables between Suva (Fiji) and Auckland, and between Sydney and Southport (Queensland). No decision had yet been taken regarding the duplicating of the cable north of Fiji.

Smoke Abatement.—On April 18th, Sir W. Sugden asked the Minister of Health if he would give special research and scientific assistance to individual industrial firms who, desiring to reduce to the very smallest limit the output of black smoke, and not always being able to use electrical power, had not up to the present time any engineering solution to this problem.

Mr. N. Chamberlain said he would gladly give what assistance was possible, having regard to the limited staff of the department. The local council was the Smoke Authority, and application should be made to it in the first instance. Efficient stoking was one of the first requirements.

Metropolitan Railway (Various Powers) Bill.—On April 19th the Unopposed Committee of the House of Commons considered this Bill, which has been promoted by the Metropolitan Railway Co. Mr. Geoffrey Cox, Parliamentary Agent, said that the principal object of the measure was to raise additional capital to the extent of £2,000,000. Under the company's previous acts certain important works were started, but owing to the outbreak of the war they were not carried out. Since then the cost of carrying out works had enormously increased and in the case of these works the excess cost over the original estimate was £383,000. In addition the company had had to spend money out of capital for new rolling stock, involving a sum of £793,000. It had also had to spend, in the extension of the generating station, a sum of £285,000; on the electrification of the line from Harrow to Rickmansworth, £168,000; and on the widening of the line to Rickmansworth £228,000. Then there was the construction and extension of the new station at Wembley Park and other smaller matters, totalling £130,000. The total capital expenditure involved was £1,979,000. The necessary shareholders' consents had been obtained. The Bill also sought extension of time for the completion of the works mentioned.

After hearing formal evidence the Committee passed the Bill for third reading.

Wireless for Fishing.—On April 19th, Sir R. Hamilton asked the Minister of Agriculture whether his attention had been drawn to experiments carried out by other countries in the combined use of aeroplanes and radio-telegraphy for the purpose of locating shoals of fish and conveying information thereof to fishing boats; and whether he would cause inquiries to be made as to the practical value of such operations in the case of British herring fleets.

Sir. Robert Sanders said the answer to the first part of the question was in the affirmative. By the courtesy of the Air Ministry experiments had been carried out and others were in contemplation, but the results so far had not been very encouraging.

Radio Broadcasting.—On April 19th, Sir W. Joynson-Hicks, after giving details of the dispute between himself and the British Broadcasting Co., said he did not consider that the agreement with the company did give it a monopoly of broadcasting. Already 87,561 broadcasting licences and 35,385 experimental licences had been issued. There were awaiting 33,000 applications for new licences, and these were being held up because of the decision of the B.B.C., which claimed the right to prevent any other manufacturer in Great Britain from manufacturing broadcasting materials in this country. He could not be a party to extending that claim. The law officers of the Crown had advised him that before he could issue an experimental licence he must be satisfied that the object was to experiment in wireless telegraphy, but if he was so satisfied—and he must be the judge of what evidence was needed—he was bound to issue the licence. That being so he proposed to send all those applications to some of his expert staff the next morning to make a thorough investigation and to advise him which were honestly intended for experiments. Those cases would be submitted to him and licences would be issued. He was exceedingly sorry that there should be this dispute between the Postmaster-General and the Broadcasting Co., but he was willing to make one further effort to secure peace, because he believed there was an enormous number of people—probably half a million—who were prepared to take out licences if they could get what they wanted. The British Broadcasting Co. said there were 200,000 infringers who had not got licences, because they could not get the licences they wanted. He wanted to give them licences, charge them 10s., and give 5s. to the B.B.C. He had declined the offer of the company that he should issue a licence to the home constructor with the clog upon it that the parts should be of B.B.C. manufacture, and also that the licence should be 20s., of which the company should get 15s. He proposed to set up the strongest committee he could get in order to investigate the whole position of broadcasting—not only the question of licences, but the desirability of the existing contract. He hoped to get three members of that House, two or three members of his own expert staff, a member of the British Radio Society, and he would ask the B.B.C. to suggest somebody to serve on that Committee. He hoped the company would be willing to put all its cards before that Committee, and he believed by that means they would be able to solve a most difficult problem and not inflict what he thought would be an undesirable monopoly on British manufacturers.

On April 24th, Sir William Joynson-Hicks announced that the terms of reference to the Committee which had been appointed to consider broadcasting were as follows:—To consider (*a*) broadcasting in all its aspects; (*b*) the contract and licences which had been or might be granted; (*c*) the action which should be taken on the determination of the existing licence of the British Broadcasting Co.; (*d*) the uses to which broadcasting might be put; (*e*) the restrictions which should be placed on its uses or development. The members of the Committee would be:—Major-General Sir F. Sykes, M.P. (chairman); Major the Hon. J. J. Astor, M.P.; Mr. F. J. Brown (Assistant Secretary of the Post Office); Sir Henry Bunbury, K.C.B.; Viscount Burnham (chairman of the Newspaper Proprietors' Association); Mr. W. H. Eccles, F.R.S. (president of the Radio Society of Great Britain); Sir Henry Norman, M.P.; Mr. J. C. Reith (general manager of the British Broadcasting Co.); Field Marshall Sir W. Robertson; Mr. C. Trevelyan, M.P.

Stoke-on-Trent Corporation Bill.—This Bill, which, among other things, seeks power to consolidate various Acts and Orders with respect to the electricity undertaking of the Stoke-on-Trent Corporation, and includes provisions for the laying of mains, &c., came before a Committee of the House of Lords, presided over by the Marquis of Bristol, on April 19th. In addition to the repeal of provisions of these Acts and Orders it seeks to incorporate the provisions of the Electric Lighting (Clauses) Act, 1899, with the Bill.

The North Staffordshire Railway Co., which is owner of, and is responsible for the maintenance and rebuilding of, several bridges over its railways and canals within the borough, petitioned against the Bill, stating that, by reason of changes in the character of the traffic using such bridges and the increase in the volume of that traffic, and of subsidences in the district, the provisions contained in the Electric Lighting (Clauses) Act, 1899, were not now sufficient for the protection of the company. It asked for the insertion in the Bill of clauses providing for the removal and replacing by the Corporation of electrical mains, pipes and works when any of the bridges had to be rebuilt, widened or altered. It was pointed out by the petitioners that under the provisions contained in the Bill the Corporation would be enabled to lay down electric wires, cables, mains or pipes crossing under the railways and canals of the company, which would interfere with the future widening or improvement of the railways or the widening or deepening of the canals. Therefore, provisions should be inserted requiring the Corporation to repay to the company any extra expenses to which it might be put in carrying out such works. It was stated that such conditions applied to gas and water undertakings, and they should also apply in the case of electric lighting undertakings. The Corporation replied, however, that it only asked that the various Acts and Orders mentioned in the Bill should be combined for the purpose of convenience, and with regard to the laying of mains it did not ask for any additional protection. There was an existing code governing the laying of electric mains and the company should be content with the protection already granted.

The Committee allowed the insertion of a clause embodying the provisions asked for by the company.

Nottingham Corporation Bill.—The Local Legislation Committee of the House of Commons, presided over by Sir Thomas Robinson, considered, on April 18th, that part of the Bill promoted by the Corporation of Nottingham which seeks power to extend the area of supply of electricity. Mr. W. E. Tyldesley Jones, K.C., for the promoters, explained that the present area of supply was the city area, and it was proposed to extend the area to include the urban districts of West Bridgford, Carlton, Arnold and Hucknall, and certain parishes in the rural districts of Basford and Bingham. All opposition to the proposed extension had been removed, with the exception of that of the urban district of West Bridgford.

The Derbyshire & Nottinghamshire Power Co. had powers to supply electricity in the district for motive power purposes,

and also to authorised undertakers, but it had agreed that it would not exercise its powers in that area.

The opposing petition of the West Bridgford Council stated that if the powers asked for in the Bill were obtained, the Corporation would obtain a vast extension of its limits of supply, without being under any obligation which would enable would-be consumers to enforce a supply on reasonable terms; and it was suggested that the Corporation wished to use its powers of supply in the future in order to help it in a future application for the extension of the city boundary. The petitioners asked that no powers should be conferred upon the Corporation which would prevent the petitioners from undertaking the distribution of energy within their own district. Counsel said that the idea of setting up a generating station for the supply of West Bridgford was hopeless, and the Electricity Commissioners would never authorise it.

A report by the Minister of Transport, on the provisions of the Bill, stated that the proposed additions to the Corporation's area of supply would enable developments to take place in those districts two years earlier than under the scheme proposed for the East Midlands Electricity District.

Mr. John H. Rider (Messrs. Preece, Cardew & Rider, consulting engineers) said he was the engineer responsible for the erection of the new station at North Wilford, which would enable the Corporation to supply energy cheaper than to-day. It would be better for the West Bridgford consumers to take energy from the distribution mains of the Corporation than of their own Council.

Mr. Wrottesley (Council for West Bridgford) agreed with the policy of generating electricity on a large scale, and was willing, if the Committee thought fit, to take a supply in bulk from Nottingham. He said that Parliament had consistently left local authorities powers to distribute electricity in their own districts, and suggested that the Committee should give the Corporation the powers asked for, but insert a provision that if, within six months from the passing of the Act, the West Bridgford Council applied for a Special Order to empower it to supply electricity, the Corporation should not oppose the application, and upon such Order coming into force, the district should cease to be within the area of the Corporation.

Replying to the Chairman, Mr. Tyldesley Jones said the total capital expenditure of the Corporation to date was £779,942, the cost of the first section of the new power station was £733,100, and the cost of works included in the present Bill was £72,897, making a total of over £1,585,000.

After deliberating in private, the Committee declared the preamble relating to Part VI of the Bill (Electricity) proved.

Electrical Power in Palestine.—On April 23rd, Mr. Ormsby-Gore, Under-Secretary for the Colonies, informed Mr. Becker that no special agreement had been come to whereby all contracts for the electrical and mechanical equipment necessary for developing electric power from the Jordan would be placed in this country, to the exclusion of all others.

Oakham Gas and Electricity Bill.—On April 24th, this Bill, which enables the Oakham Gas Co. to supply electricity, was considered by the Unopposed Committee of the House of Lords, and was ordered to be reported for third reading.

REVIEWS.

Electrical Engineering Laboratory Experiments. By C. W. Ricker and C. E. Tucker. Pp. xiv+310; figs. 138. London: The McGraw-Hill Publishing Co. Price 11s. 3d. net.

This book is written specially for the use of students in the laboratories of technical schools and colleges, and is, therefore, to be regarded as educational in its purpose and not as a laboratory manual for general reference by readers having more utilitarian aims.

The writers state their view of the way in which the experimental work of the laboratory should be conducted after the fundamentals have been mastered in the following terms:—The student should be assigned work which will require original thinking, and be required to rely, more or less, upon his own resources. He should be encouraged to hunt up some problem in which he is particularly interested and tackle it as a real research proposition. In this way he will unconsciously exercise his initiative and prefer to rely upon his own resources.

In framing a laboratory course in accordance with these principles, the authors have purposely omitted a great deal of information which may be gleaned from other text-books, and have generally refrained from any discussion of the results or conclusions derived from the experiments. The results and their interpretation, are left to be recorded in the student's note-book, and the authors usually do little more than suggest the nature of the observations to be made; they then ask a number of questions to which the student is expected to find the answer from his experimental results or by deduction from theory derived from other sources.

From this brief account of the general method pursued in the book, it will be seen that this plan could only be effective with students already possessing an adequate foundation of knowledge and could only be practiced in a laboratory with ample equipment and a sufficient staff to give individual guidance in cases of difficulty; while a liberal allowance of time must be available for laboratory work. Given these conditions, as they should be in colleges of university type, the methods here outlined are undoubtedly right, and the book before us makes useful suggestions to the desired end. It is, however, to be remembered that experimental work in electrical engineering is not only conducted in university laboratories and by undergraduate students and that for many students a somewhat different procedure and a different emphasis on the practical and utilitarian purposes of experimental measurement may be necessary—or even desirable.

Coming to a more detailed consideration of the contents of the book, the first chapter deals very briefly with various instruments, the most useful section being that concerned with the methods of connecting the wattmeter, ammeter and voltmeter in a circuit so that the losses in the instruments shall produce a minimum error. The second chapter deals with the estimation of the ranges of instruments required for machine tests in order that the correct instruments may be selected for use; this is a subject worthy of more consideration than it usually receives, since it makes it necessary for the student to visualise the course of the experiment before he begins to make any measurements. A third chapter deals with the writing of reports of experiments after the measurements are completed.

After these introductory chapters, the book is devoted to instructions for carrying out the various experiments. Each experiment is preceded by a short account of the principle of the machine or apparatus, and is followed by a series of headings of "Results Required,"—some of which call for the exercise of considerable powers of deduction—and, finally, a series of references to text-books or other sources of information bearing on the subject of the test.

The first eight experiments deal with the Wheatstone Bridge, potentiometer, conductivity and fault tests on cables, &c. After these follow a series of tests on continuous current machines, covering the whole range usually carried out. Then comes a series of measurements on alternating current circuits followed by experiments on alternating current machines of the usual types. In all, the number of experiments is fifty-six, covering probably a two-years' course of laboratory work of the college course.

The alternating current section appears to the reviewer to be less helpful than the part dealing with continuous current machines, partly because the more complicated relationships demand a further discussion than is possible in the brief space allotted, but also because the authors seem less happy in their treatment of this subject.

Experiment 32 on the effective resistance of an inductance coil is little calculated to promote a clear conception of the effect of eddy currents in an ordinary inductive coil, which is the object of the test. A vector diagram is given in which the "effective resistance drop" consists mainly of energy voltage which is independent of the "ohmic resistance loss" due to the main current. Further, the obvious bearing of this experiment on the determination of the effective resistance of transformer windings mentioned a couple of pages later seems to have been completely overlooked.

To sum up the reviewer's impressions of the usefulness of the book to British readers: it presents an outline of a good course of experimental machine testing, in which perhaps the most valuable feature is the suggestions for the extension of the experiments usually carried out and the hints as to deductions and reasoning based on them. For teachers, this feature may prove helpful, and for a few students also who desire to extend the usual range of their measurements. As a laboratory companion for general laboratory work, the omission of discussions of the actual results to be expected will probably be found a disadvantage, especially as the references to sources of information are almost exclusively to American publications. The descriptions of apparatus and limits of allowable temperature rise, &c., are also based on American practice. In short, it does in a competent manner what several books in general use already do, and, although possessing certain merits of its own, it cannot be recommended as likely to be more generally useful than several well-known text-books already in use in this country.

Costing Organisation for Engineers. By E. W. Workman, B.Sc. Pp. x+86; figs. 28. London: Sir Isaac Pitman and Sons, Ltd. Price 3s. 6d. net.

A more suitable title for this work would have been "Costing Organisation for Student Engineers." The work is elementary and the procedure described is already known and, in fact, must necessarily be to the engineer, the cost accountant, and others engaged in this particular class of work.

However, as stated in the foreword by Mr. A. P. M. Fleming, C.B.E., M.Sc.Tech., M.I.E.E., the book can be cordially recommended to every young man engaged in engineering manufacture.

The author, in the first two chapters, deals with the well-known fundamentals of costing, but we certainly do not agree with him on his allocation of office on cost expenses, namely: page 6, item 6, carriage outwards, packing materials, printing, stationery, postage, advertising, &c. Carriage outwards and

packing materials is wrongly charged to what is really "establishment charges," and has no relation whatever to the administrative department, and this burden charge "Carriage Outwards and Packing" is, without question, a factory overhead charge; in fact, in many cases, such as carriage and packing on a turbo set, it need not be an overhead charge but a direct charge to the particular job.

Chapter 3: "How a Consumer's Order is dealt with" is told in narrative manner from the receipt of order to the ultimate shipment.

The author in Chapter 6 describes "Factory Overhead Expenses" by the percentage method and the machine-hour rate method. This chapter could have been augmented by a few simple examples of the fallacy in certain cases of the percentage method of overhead burden.

The concluding portion of the work describes well-known office machinery, such as adding and calculating machines, duplicating machines, addressing machines, &c., &c., and deals with a description of the Hollerith system, containing also an interesting chapter on cost statements and returns.

Wireless Component Parts, and How to Make Them. Edited by Bernard E. Jones. Pp. 124; figs. 208. London: Cassell & Co., Ltd. Price 1s. 6d. net.

This is the first volume of the "Amateur Wireless" Series of Handbooks, which are to be closely allied to the "Work" Handbooks issued by the same publishers. It has been compiled from the columns of the weekly journal, *Amateur Wireless*, by the editor of that publication, and should prove useful to amateurs who wish to construct crystal detectors, variometers, and other tuning coils, condensers, rheostats, transformers, or test buzzers.

THE ELECTRICAL CONTRACTORS' ASSOCIATION (INC.).

Annual Dinner.

On Tuesday last the annual dinner of the Electrical Contractors' Association (Incorp.), the N.E.C.T.A., Ltd., and the National Federated Electrical Association was held at the Café Monico, London. Mr. Howard Marryat (President) was in the chair, and the guests numbered about 140, including Mr. W. W. Lackie, C.B.E. (Electricity Commissioner), Mr. C. H. Wordingham, C.B.E., Sir T. O. Callender (chairman, C.M.A.), Mr. Ll. B. Atkinson (director, C.M.A.), Mr. Frank Gill, O.B.E. (president, I.E.E.), Mr. E. J. Partridge, F.S.I. (president, Society of Architects), Mr. W. B. Woodhouse (president, E.D.A.), Mr. D. S. Munro (president, E.C.A. of Scotland), Mr. G. Donovan (president, E.W.F.), Mr. P. J. Brewer (chairman, E.L.M.A.), Mr. J. Y. Fletcher (chairman, E.T.B.I.), and many other well-known representatives of the profession and industry.

After the loyal toast, Mr. C. H. Wordingham proposed "The Allied Associations and Honorary Officials," remarking that the position of importance and responsibility which the former had attained was largely due to the work of their presidents. The Associations had not used their great power for the purpose of forcing up prices, but for the improvement of the standard of work done by their members, emulating in that respect the example of the Cable Makers' Association, with which they were closely co-operating; the inquiries of the Committee on Profiteering proved that the operations of the C.M.A. were beneficial to the industry, and that it was worth while to pay more for C.M.A. products. The proposal that contractors should be voluntarily registered had been most warmly supported by the Association. With regard to wiring rules, he was one of the oldest members (and chairman) of the Wiring Rules Committee of the I.E.E., on which most conflicting interests were represented; the municipal section wanted compulsory rules, the company section no rules at all, whilst other members wanted rules minutely detailed. No other industry tried to regulate through and through by one set of regulations; in these rules they tried to teach the wiring man how to carry out his work, and they endeavoured to make them applicable to all sorts of jobs—in his opinion, an impossible task. Perhaps it would be better to leave the whole matter to the E.C.A. in conjunction with the registration authority. They should have only a few rules, specifying the results that were to be attained. There was no power to enforce any wiring rules at all—nor was it likely that there would be such power in the future. If the registration authority became sufficiently strong, it should be able to ensure good work without such rules.

Responding, Mr. Marryat suggested that if the I.E.E. Wiring Rules were withdrawn, the old conditions would return, under which every supply undertaking and fire office issued its own set of rules. The contractors supported the registration scheme wholeheartedly, and hoped that it would be supported also by those who had the placing of orders. Registration would not tend to narrow the trade; the door to registration was far wider than the door to enter the E.C.A.—but it would place difficulties in the way of the incompetent. No association supported the smaller man so consistently as the E.C.A.; but there were two classes of small man in the business. For those who were "here to-day and gone to-morrow" there was no room in the Association; those who entered the business with ideals and earnestness it supported and fought for. During the last few years the Association had succeeded generally in gaining the goodwill of the supply station engineer; but there was something in the make-up of a "pucka" engineer which was inconsistent with "shopkeeping." They had had a fight at Leicester, and won, and ever since then they had been on the very best terms with the city engineer and other interested parties, but in some other places they had not succeeded in educating the station engineer with regard to the necessity of co-operation for the purpose of development. In many places large sums were being spent on extensions of mains, but the engineer would make no concession to the contractors—and even charged them the maximum price for energy used to demonstrate the virtues of electrical appliances, which would result in the consumption of hundreds of units.

The fundamental fault was the lack of organisation of the *whole industry*, with the result that selling costs were enormously inflated, and retailers could not embark on a selling policy with confidence. The electrical industry in this country was unique in failing to recognise that success depended ultimately on the maintenance of a prosperous body of retailers. There were immense possibilities of expansion in the industry. The solution of the problem was an understanding on the fair division of labour: let the manufacturer manufacture at the lowest possible cost; the wholesaler wholesale at the lowest possible cost; and the retailer retail at the lowest possible cost. The Electrical Contractors' Association had that day issued a declaration of its trading policy. It was the result of six months' hard work. They had been careful to consult gentlemen who were prominent in other sections of the industry, in order to make sure that their proposals were reasonable. He hoped that other sections would follow their example; and if material differences of view were met with, the contractors were ready to give as well as take.

Mr. W. R. Rawlings proposed "The Guests" in a humorous speech, in the course of which he referred to the esteem with which the contractors regarded the Institution of Electrical Engineers, and the good fellowship with which the latter met the former—a change of attitude largely due to those who had recently occupied the presidential chair, and particularly to Mr. Wordingham. Mr. W. W. Lackie, responding, said that the Association represented a vital factor in the industry, and the Electricity Commissioners wished the contractors all success. There was distinct evidence of improvement in the electrical industry, and if they compared London, for instance, with Chicago, it would be seen that there was immense scope for further development. Mr. Frank Gill, also responding, referred to the yeoman service rendered by the representatives of the contractors on the Council of the Institution. With regard to wiring rules, he commented on the wide and successful use of surface wiring on the Continent, and asked whether electrical engineers in this country were not too meticulous. The public needed educating, and Mr. Beauchamp was appealing for a slogan which should apply to all branches of the industry. Team work was vitally important; as in football, they should not all run for the same job, but should instantaneously recognise whose job it was, and then help that man to do the work.

Mr. W. B. Woodhouse, the third respondent, said he was in complete agreement with almost all that had been said that evening. The Electrical Development Association's aim was to enlighten the public, and to bring together the various sections of the industry, so that all should pull together. Let them "Wire in!"

Mr. H. Marryat, proposing "The Electrical Trades Benevolent Institution," referred to the time that was coming when they would have to provide pensions, for which the interest on a capital of £20,000 was insufficient; he knew of a similar fund of £100,000, which last year had had to draw on its capital to meet urgent needs. He put up to auction a treasured autograph letter of Faraday's, which was purchased by Mr. J. Orringe for ten guineas, whilst donations brought the total addition to the funds of the E.T.B.I. up to £51 12s. 6d.

Responding to the toast, Mr. J. Y. Fletcher paid a tribute to the work of the honorary secretary of the Benevolent Institution, Mr. F. B. O. Hawes, and expressed the gratitude of the Institution to Mr. Marryat for the gift of the Faraday letter. The fund amounted to £20,000 odd, but they now aimed at £50,000—no great burden on so great an industry. They should get members of their staffs to join the E.T.B.I. as subscribing members—the cost was only 10s. a year; whilst the big manufacturing firms had built up their own pension funds, smaller firms were not in a position to do so, and the E.T.B.I. would serve that purpose for them.

Mr. H. J. Cash proposed the health of the Chairman, to whose efforts the new trading scheme was almost entirely due, and the toast was drunk with musical honours. In acknowledging the compliment, Mr. Marryat expressed his indebtedness to the labours of the secretary, Mr. L. G. Tate.

The toast list was interspersed with musical items, and the proceedings were thoroughly enjoyable.

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BUSINESS NOTES.

Bankruptcy Proceedings.—Archibald Smith, electrician (trading as Smith & Gill), 57, Albion Street, Nelson.—At the Burnley Bankruptcy Court, on April 18th, it was stated that debtor, who should have appeared on January 17th, had now "surrendered to the jurisdiction of the Court." He gave as the cause of failure bad trade, want of capital, inefficiency of partner, and heavy expenses. He started business in December, 1920, with Frank Gill, each putting in £20. The business did not pay. In 1921 the partnership was dissolved. Debtor continued until March, 1921, when the premises were destroyed by fire, with the stock. He got £440 insurance, the stock being worth £500 or £600. He carried on the business to September, 1922, although he had no stock. He went to Leicester to work for a firm. Leaving there in December, 1922, he went to Rio de Janeiro, taking with him £25 to £30 in cash, after paying £30 for his passage. Debtor said that in August, 1922, he offered his creditors 9s. in the £, which was refused. Asked how he spent £440 from the insurance, debtor said he paid it out to former creditors and bought goods to complete jobs. He also spent money on new stock, because he expected more business. Trade seemed on the turn. He took the stock away to Leicester because the electrical trade there was good. Mr. Plant (Official Receiver): How long did you stay in South America.—About six weeks. Why did you come back?—I realised I had done wrong. When the business was going, he drew £8 a week from it. Of that he gave £3 to his wife and kept £5 for himself, his expenses were high. The hearing was adjourned.

Albert Dawson Froggatt, trading as Froggatt & Middleton, 15, Sheaf Street, Sheffield, engineer.—The following are creditors herein:—

	£		£
Atlas Advertising Association ...	18	*Model Engineer*	11
Armstrong, Whitworth & Co., Ltd.	41	Mining Engineering Co. ...	15
Ashton, Thos. A., Ltd.	16	McCullam & Co., Ltd.	19
Bradford Gas Engine Co., Ltd.	35	Neill, R., & Co.	80
Brook Shaw	16	Page, A., & Son	27
Barlow Engineering Co., Ltd.	32	Parker & Marney	19
Burney & Blackburne, Ltd. ...	13	Petters, Ltd.	93
Crown Manufacturing Co., Ltd.	25	Stuart Turner, Ltd.	39
Crossley Bros., Ltd.	12	Standard Hack Saw Co., Ltd.	14
Detroit Engine Co.	143	*Sheffield Daily Independent* ...	15
Firth & Russell	138	Sturmey Archer Gears, Ltd. ...	32
General Electric Co., Ltd. ...	41	Wood, Milne, Ltd.	23
Howells & Co., Ltd.	41	Webber, J. M., & Co., Ltd. ...	13
Hallamshire Electric Co., Ltd.	16	Sheffield Electric Co.	12
Morris & Co.	51	Stella Lamp Co.	30

Norman Rutherford Dickinson (trading as D. H. Engineering Co., 60½, Windus Road, Stoke Newington, electrical engineer.—The first meeting of creditors herein was held on Monday at the London Bankruptcy Court. The Official Receiver reported that it appeared from the debtor's statements that he began business for himself in 1916, with £50 capital, at West Green Road, as a general engineer, dealing with cars and electrical fittings. He did fairly well until he joined the army in 1916; he served until September, 1919, and shortly afterwards resumed business in partnership at Windus Road, and traded as the D. H. Engineering Co. The partner retired in April, 1920, receiving nothing for his interest, and the debtor continued the business alone. It had declined latterly in consequence of the trade slump; the failure was further attributed to bad debts and litigation. The liabilities were returned at £483, and in the absence of assets the case was left with the Official Receiver to be wound up in bankruptcy.

James Ashton Johnson, 1, Dragon Parade, Harrogate, Engineer.—The first meeting of creditors was held on April 18th at the Court House, Raglan Street, Harrogate. The case being a summary one, was left with the Official Receiver as trustee of the estate.

O. Greathead and W. Greathead (Greathead Bros.), electrical engineers and contractors, 50, Burnley Road, Brierfield, Lancaster.—Last day for proofs for dividend, May 1st. Trustee, Mr. C. H. Plant (Official Receiver), 13, Winckley Street, Preston.

Henry Farnell, 183, Higher Hillgate, Stockport, plumber and electrician.—The public examination of this debtor was held on April 17th at the Court House, Vernon Street, Stockport. According to the statement of affairs, the liabilities amounted to £866, against assets of £41, or a deficiency of £624. Debtor attributed his failure to sickness in family and losses on contracts. He commenced business in 1908 at Heathland Terrace and continued there until 1910. Later he removed to his present address. In 1912, when the liabilities amounted to £250 and assets £200, debtor made an arrangement with his creditors. He recommenced business in 1918 and executed a deed of assignment on January 29th last. After further questions the examination was closed.

A. Wilson, electrician, Market Place, Howden, Yorks.—Receiving order made April 17th on debtor's own petition. First meeting May 1st, at the Official Receiver's office, Hull. Public examination, May 7th, at the Guildhall, Hull.

S. E. Needham, electrical and mechanical engineer, trading with three partners at 20, Park Road, and 131, Benton Way, Wallsend.—Receiving order made April 14th on debtor's own petition. First meeting, May 2nd, at the Official Receiver's office, 4, Northumberland Street, Newcastle-on-Tyne. Public examination, May 3rd, at the County Court, Newcastle-on-Tyne.

F. H. Dennis, electrical engineer, 20, High Street, Chelmsford.—Last day for proofs for dividend May 9th. Trustee, Mr. T. Gourlay, 29, Russell Square, W.C.1.

W. Price, electrician, 29, Russell Street, Plymouth.—Adjourned meeting of creditors, April 30th, at 11, St. Aubyn Street, Devonport.

W. A. Davis, electrical engineer, late of 3, Coronation Street, Leeds.—Last day for proofs for dividend. Trustee, Mr. H. C. Bowling, Official Receiver, 24, Bond Street, Leeds.

F. Wilde (Liverpool Engineering Co.), electrical engineer, 18 & 20, Vauxhall Road, Liverpool.—Last day for proofs for dividend, May 5th. Trustee, Mr. L. Nicholas, 19, Castle Street, Liverpool.

E. G. Rowe (Davies & Rowe), electrical engineer, 119, Dunraven Street, Tonypandy.—Last day for proofs for dividend, May 12th. Trustee, Mr. E. Owen, Official Receiver, 34, Park Place, Cardiff.

Company Liquidations.—Cork Electric Free Wiring Co., Ltd.—A general meeting of creditors was convened for the 24th inst. at Cork. Liquidator: Mr. John O'Leary.

Grimsby Electric Vehicle Co., Ltd.—A meeting is called for May 18th at 103, Victoria Street, Grimsby, to hear an account of the winding up from the liquidator, Mr. W. M. Dawson.

Magnus Volk, Ltd.—Winding up voluntarily for reconstruction purposes. Liquidator, Mr. R. Carpenter, Midland Bank Chambers, North Street, Brighton. Meeting of creditors May 4th, at 58, Ship Street, Brighton. All creditors have been or will be paid in full.

Anode Wireless and Scientific Instruments, Ltd.—First meetings of creditors and contributories, May 2nd, at Carey Street, W.C.

Cedes Electric Traction, Ltd.—Liquidator, Mr. H. E. Burgess, Senior Official Receiver, Carey Street, W.C., released April 16th.

Anglo-French Wireless Co., Ltd.—A meeting of members is called for May 28th, at 10 and 12, Bishopsgate, E.C., to hear an account of the winding up from the liquidator, Mr. S. Powell.

Private Arrangements.—Correction.—In the reference to the matter of A. J. Barlow last week, our reporter inadvertently gave the trading name as "Barlow Bros. & Co." instead of Barlow Bros. The address was correctly given as 9, Brunswick Place, E.C. We wish to make it quite clear that the matter in no way relates to Messrs. Barlow Bros. and Co., electric light and power engineers, whose address is Albion House, 61, New Oxford Street, London, W.C.1. We regret that the report has occasioned them inconvenience.

D. J. Chambers, electrical engineer, Volta Works, Dawber Street, Wigan.—The creditors interested herein were called together on April 19th, when a statement of affairs was presented which had been prepared by Messrs. Scampton and Brown, I.A., 28, Market Street, Wigan. The statement disclosed liabilities of £847, of which £553 was due to the trade and £295 to a cash creditor. In addition there was a fully secured creditor for £40 who held a bill of sale on household furniture valued at £70. The assets were estimated to realise £351, from which had to be deducted £115 for preferential claims, leaving net assets of £236, or a deficiency of £612. The assets consisted of: Cash in hand 5s. 8d.; stock at cost £246, expected to produce £196; fixtures and fittings £85; book-debts, £59, valued at £39; and surplus from fully secured creditors £30. It was reported that the debtor was a member of the Institution of Electrical Engineers, and after being employed by a public authority, he acted as manager for a firm of electricians. He commenced trading on July 3rd, 1921, in partnership, but the partnership was dissolved last September, and notice of the dissolution was sent to the creditors. The deficiency was accounted for by the depreciation written off the assets, together with a loss on a contract, while the total drawings since the commencement had been £456. The capital when the business was commenced consisted of £14 found by the debtor. A resolution was passed in favour of the matter being dealt with under a deed of assignment with Mr. A. H. Scampton as trustee.

The following are creditors:—

	£		£
Bridge Electrical Co.	48	Ward & Goldstone, Ltd.	23
General Electric Co., Ltd. ...	189	White, J. C.	26
Kirwan, M. B.	15	Sutton, B. (exors. of)	294
Roger & Rennick	12	Castle Engineering Co.	29
Smith & Cookson	32	Smith, J. & W. B., Ltd. ...	16

C. R. Small, trading as the Clacton Electrical Co., High Street, Clacton-on-Sea.—The creditors interested herein were called together on April 20th, at the offices of Messrs. Poppleton, Appleby & Hawkins, accountants and auditors, 4, Charterhouse Square, E.C. A statement of affairs was presented which disclosed liabilities of £2,623, of which £623 was due to the trade and £2,000 to cash creditors. There was also a fully secured creditor for £500, who held securities estimated at £1,200. The assets consisted of: Stock at cost, £350, expected to produce £200; book-debts, £150, estimated to realise

£100; cash in hand, £86; and surplus from fully secured creditors, £700. The assets, therefore, totalled £1,086, or a deficiency of rather more than £1,500. It was explained that the fully secured creditor was the bank, and it held the deeds of the freehold property. The cash creditor was Mr. Small, senior, who had intimated that if the matter was dealt with privately he would stand aside until the other creditors had been paid in full. The debtor commenced business after being demobilised in 1920. The freehold premises were purchased for £1,200 and £500 was expended on fitting them up. Negotiations were taking place for the sale of the property and it was believed that there was every prospect of the figures mentioned being obtained. After a short discussion, it was unanimously resolved that a deed of assignment should be executed to Mr. E. H. Hawkins, while a committee was appointed consisting of the representatives of Messrs. Clark, Hunt & Co., Messrs. J. & W. B. Smith, Ltd., and the British Thomson-Houston Co., Ltd.

The following are creditors:—

	£		£
Abbey Sports Co.	30	Midland Gas & Water Co. ...	25
Bennett Bros., Ltd.	11	National Electric Supplies ...	34
British Thomson-Houston Co., Ltd.	33	Siemens Bros. & Co., Ltd. ...	16
		Ever-Ready Co.	29
Bryan, L. G. C.	14	Clark, Hunt & Co., Ltd. ...	78
Callender's Cable & Construction Co., Ltd.	11	General Electric Co., Ltd. ...	12
		Hawkins Bros., Ltd.	21
Elvin Jones & Co., Ltd.	12	Quick & Co.	17
Edison & Swan Electric Co. ...	24	Smith, J. & W. B., & Co. ...	38
Johnson & Phillips, Ltd.	24	Simplex, Ltd.	12
Llewellen & Co., Ltd.	11		

Dissolutions of Partnership.—Mitchell & Rukin, electrical engineers, 20, Silverdale Road and 32, Tichborne Road, Bradford.—Mr. B. Rukin and Mr. J. P. Mitchell have dissolved partnership. Mr. J. P. Mitchell will continue the business in his own name at 20, Silverdale Road.

General Electric Motor Engineering Co., motor engineers, Rydall Street, Eastern Boulevards, Leicester.—Mr. F. A. Dunmore and Mr. W. J. Walters have dissolved partnership. Debts will be attended to by Mr. Dunmore.

A. E. Hunt & Sons, electrical engineers and contractors, Herne Bay Electricity Works, Herne Bay.—Messrs. A. E. Hunt, E. Hunt, D. E. Hunt, A. J. Hunt, A. W. Hunt and A. G. Hunt have dissolved partnership, so far as regards Mr. A. E. Hunt. The remaining five partners will attend to debts and continue the business.

Trade Announcements.—Messrs. F. & A. Parkinson, electrical engineers, of Guiseley, Yorkshire, have established a branch works near Sydney, Australia, to cope with the growing Australasian trade in electrical machinery. The idea was conceived as a result of a business tour round the world about five years ago by Mr. F. Parkinson, senior director of the firm, and the Sydney factory is now working at full pressure. The firm states that the demand for a standardised motor, with rapid delivery, usually from stock, fills a much-needed requirement in Australia.

Mr. L. W. Foote, who has been associated with the various Siemens companies for the past 15 years, in South Wales, has resigned his position and will commence business, on May 1st, as agent and factor under his own name, at 73, Plymouth Road, Penarth, South Wales.

The telephone number of Mr. J. S. Plumtree is "Chancery 8121."

Messrs. Ascog, Ltd., are to-day moving their offices to 13, Sackville Street, Piccadilly, W.1.

The Suburban Electrical & Maintenance Co. has taken new showrooms at Plough Yard, Shoreditch, E.C.2. Telephone: "Central 3286."

The J. L. Electric Co., of Birmingham, has made arrangements for the "J.L." universal wiring clip to be exclusively manufactured for and distributed by Mr. Walter Balmford, Electric House, Whittall Street, Birmingham, and all correspondence concerning it should be addressed to him.

Catalogues and Lists.—Messrs. Watson & Sons (Electro-Medical), Ltd., Sunic House, Parker Street, Kingsway, W.C.2.—A well-illustrated brochure describing the X-Ray Wing of the Royal Infirmary, Manchester.

The English Electric Co., Ltd., Queen's House, Kingsway, W.C.2.—Publication No. 364, illustrating and describing the "English Electric" asynchronous-synchronous motor and accessories.

We have received a copy of the U.E.C. pocket diary for 1923 from the University Engineering College, Westgate-on-Sea.

The Walsall Electrical Co., Ltd., 57, Bridge Street, Walsall.—An illustrated pamphlet describing a crystal broadcasting receiving set.

The Swedish General Electric, Ltd., 5, Chancery Lane, W.C.2.—Stock List No. 112, containing particulars of a.c. and d.c. motors and starters, generators, printing press equipment, &c. Also a well-illustrated brochure describing electrical equipment for printing and allied trades.

Vislok, Ltd., 1, St. Bride's House, Fleet Street, E.C.4.—A number of pamphlets describing the "Vislok" lock-nut.

Messrs. Thompson & Co., 48, Watling Street, E.C.4.—An illustrated booklet describing recording wattmeters, voltmeters, &c., made by the Société Industrielle pour la Fabrication d'Appareils de Mesure.

Messrs. Cecil Hodges & Co., Ltd., Empire Works, Dalston Lane, E.8.—An illustrated catalogue dealing with the "Grippa" distribution system. Priced.

The Arora Co., Rosebery Street, Loughborough (Leics.).—An illustrated and priced pamphlet dealing with "Arora" electric cooking apparatus.

Messrs. Higgs Bros., Sand Pits, Birmingham.—Price List No. 8, containing particulars of a.c. and d.c. motors and d.c. generators.

Messrs. Kelvin, Bottomley & Baird, Ltd., 18, Cambridge Street, Glasgow.—An illustrated pamphlet giving a full description of the "Econometer" portable CO_2 tester.

Book Notices.—"A Handbook of Testing." Vol. II. "The Theory of Prime Movers," by C. A. Middleton-Smith and A. G. Warren. Pp. xi+299; 246 figs. London: Constable and Co., Ltd. Price 22s. 6d. net.

"*Journal* of the American Institute of Electrical Engineers." Vol. XLII. No. 4. April, 1923. New York: The Institute. $1.

"Comment Recevoir la Téléphonie sans fil," by J. Roussel. Pp. 272; 126 figs. Paris: Librairie Vuibert. Price 6 fr.

Australian Electrical Conditions.—The annual report of the Electrical Employers' Association for 1922, which was recently abstracted in the *Sydney Morning Herald*, shows that the year was a busy and successful one. The report deals with arbitration matters, principally with regard to a reduction of wages and eight hours secured by the association. The report says: "In the early part of the year a proposal was brought before the association to the effect that members should refuse to trade in electrical apparatus and fittings made in Germany. In view of the preferential tariff and the anti-dumping law, it was deemed advisable to make inquiries before committing members to any such course of action. Correspondence, lengthy and protracted, between this association and the Tariff Board eventually cleared up the position, and your executive was eventually placed in possession of information which made it appear that no such resolution as had been proposed was necessary."

The report further points out that, despite the defeat of a Labour Government, with its policy of State enterprises, day labour, &c., the Government of the State still continues to act as consulting engineer, electrical contractor, and general constructor of works for country municipalities and shires. "From all quarters," it proceeds, "complaints are reported of works unduly delayed, plants costing much more than the estimates, and so on. This association, towards the end of the year, passed resolutions protesting against this unfair competition on the part of the Government with private enterprise; but, owing to the large amount of work required to be done in regard to matters in hand, it was not possible to take any further action at that time beyond the appointment of a sub-committee to place the views of the association before the authorities. The necessary steps will, however, be taken at the first opportunity this year."

The report was adopted at the annual meeting of the association. Mr. A. Maughan (general manager Australian General Electric Co., Ltd.), was elected president for the ensuing year.

For Sale.—Hampstead Borough Council Electricity Department invites offers for two Thompson water-tube boilers, complete with chain-grate stokers, superheaters, coal elevators, ash-removing plant, motors, &c., also a feed-water heater detartariser.

Messrs. Norman & Son will sell by auction, on April 25th, at 5, Little Britain, electrical fittings, machinery, cable, lamps, &c. (See our advertisement pages to-day.)

British Trade Mark Applications.—The following are included among the recent applications for British trade marks. Objections may be lodged within one month from the dates mentioned.

Aeolian. No. 427,075. Class 8. Apparatus for wireless telegraphy, wireless telephony, and radio instruments generally, and parts thereof. The Aeolian Co., Ltd., 131-7, New Bond Street, London, W. April 18th, 1923.

B.B.C. (lettering and design). No. 433,252. Class 8. Apparatus for wireless telegraphy or telephony. The British Broadcasting Co., Ltd., Magnet House, Kingsway, London, W.C. April 18th, 1923.

Crystalve. No. 434,334. Class 8. Apparatus and instruments for wireless telegraphy and telephony. The Crouch End Motor & Engineering Co., 44-8, Coleridge Road, Crouch End, London, N.8. April 18th, 1923.

Protaophone. No. 434,958. Class 8. Sound reproducing machines and parts thereof. Arthur S. Morris, 88, Leadenhall Street, London, E.C. April 18th, 1923.

Gecospeeka. No. 434,531. Class 8. Apparatus for wireless telephony. General Electric Co., Ltd., Magnet House, Kingsway, London, W.C. April 18th, 1923.

Gecovox. No. 434,532. Class 8. Apparatus for wireless telephony. General Electric Co., Ltd., Magnet House, Kingsway, London, W.C. April 18th, 1923.

Copper and Lead Prices.—Messrs. F. Smith & Co. report April 25th:—No change in electrolytic copper prices.

Messrs. James & Shakespeare report April 25th:—Copper bars (best selected), sheet and rod, no change; English pig lead, £27 5s., 10s. decrease.

Furnaces Restarted.—Four blast furnaces which have been out of operation for two years at the Stanton Ironworks were re-started on 20th inst. by Mr. J. R. Clynes, M.P.

Local Exhibitions.—Braintree.—East Anglian Electricity, Ltd., held an electrical exhibition from April 23rd to 27th, inclusive, at the local Institute Hall. Practical demonstrations of apparatus were arranged, and the appliances shown included cookers, fires, vacuum cleaners, &c., as well as radio-telephone apparatus. A small admission charge was made and the proceeds were handed to the local cottage hospital.

Perth.—A "Utility Exhibition" is to be held in the city from May 23rd to 26th. Numerous applications for stand space have been received from well-known firms all over the country and from London. Labour-saving devices for the workshop and home, and radio installations will be among the exhibits.

Dublin.—Electrical and scientific apparatus and machinery of all kinds were shown at an exhibition in the Engineers' Hall, Dublin, organised by the Dublin Society of Model and Experimental Engineers. The Great Southern & Western (Ireland) and Midland, Great Western (Ireland) railway companies, all the leading city firms, and many English firms, contributed to a most interesting display.

Wimbledon.—Excellent results are reported from the recent electrical exhibition. Orders for the hiring of 106 cookers were taken, apart from orders for a large number of kettles and irons.

The Sixpenny Budget.—We reproduce the following from the *Financial Times*:—

For This Relief, What Thanks?

(*By one of the Income-Taxed.*)

We thought, at the least, that a shilling 'twould be,
So terribly stringent as *are* things;
And yet, I suppose, very thankful are we
That it isn't a penny-three-farthings!
From what I can see of the Chancellor now,
When dealing with profits on paper,
He's almost inclined in his way, anyhow,
To follow the lead of the draper. F.W.

Sequestrations.—Ayrshire Electrical Co., New House, Kilburnie, and W. Close, electrician, 29, Central Avenue, Garden City, Kilburnie, the only known partner of the said company.—Meeting of creditors, April 30th, at the Lesser Oddfellows' Hall, John Finnie Street, Kilmarnock. Agent, Mr. J. M. Inglis, 60, Bank Street, Kilmarnock.

Examination.—J. Menzies, electrical engineer, 208, Quarry Street, Hamilton.—Examination, April 24th, at the Court House, Hamilton. Meeting of creditors, May 4th, at 87, St. Vincent Street, Glasgow.

Our Foreign Trade.—March Figures.—The following were the values of imports and exports of electrical goods and machinery during March, 1923:—

	Mar., 1923.	Inc. or dec.	3 months, 1923. Inc. or dec.
Imports—	£	£	£
Electrical goods and apparatus	143,616	+ 28,106	+ 161,548
Machinery	734,156	− 40,189	+ 304,053
Exports—			
Electrical goods and apparatus	632,933	+ 23,462	+ 25,870
Machinery	3,647,770	−2,234,253	−3,646,302
Re-exports—			
Electrical goods and apparatus	5,460	− 12,216	− 25,210
Machinery	82,820	− 179	+ 29,440

"English Electric" Activities Abroad.—In the course of an informative circular which has been sent out to shareholders of the English Electric Co., Ltd., along with copies of the annual report and accounts, the following notes appear regarding what the company is doing outside the United Kingdom:—"At the present moment the company's engineers are putting plant into operation in every corner of the globe. In New Zealand it is railway electrification, in China steam turbines and electrical equipment in textile mills, in Australia tramway motors, in Japan and in France electric locomotives, in India a new power station, colliery plant, cotton mill equipments, in Egypt, in Zanzibar, in Barbadoes Diesel engines. There is no country so remote from the beaten tracks of civilisation that it has no market to offer for the company's products. In Nepal, in Brazil, and in the heart of Africa, machinery constructed in Rugby or Preston, Stafford or Bradford is carried to its destination, far beyond the reach of steamer or railway, on the backs of mules or other beasts of burden. So universal is the need for modern engineering appliances."

A Hull Tramway Contract: Material Must be British.—An interesting situation has arisen at Hull. Press reports show that the Unemployment Grants Committee has refused to make a grant to the Corporation for extensive track renewals on the ground that rails and accessories required are being obtained from Belgium. The Committee states that its funds are for the relief of unemployment in this country, and that it has been recently laid down that local authorities must place contracts in this country in relation to relief works assisted by Government grants. By accepting the Belgian tender for 2,000 tons of rails and accessories the Tramways Committee expected to save £10,000 on the lowest British tender.

It is stated that the Tramways Committee had hoped to get a grant of £15,000 towards the cost of renewals, but they would probably save £5,000 through the contractor being able to engage labour direct instead of through the Labour Exchange, so that the position would not be materially affected. The Town Clerk said that they were not aware of the condition requiring all contracts to be placed in this country, and it was decided to make representations to the local members of Parliament. The lowest British tender was that of Messrs. Steel, Peech & Tozer, and apparently there were several very bitter discussions in the City Council before the decision to send the order abroad was arrived at.

Unemployment.—According to the Ministry of Labour returns, the number of persons wholly unemployed on April 9th was 1,260,700, a reduction of 23,893 on the week. It is stated that the reduction occurred mainly in Lancashire and Cheshire. There was a further reduction of 21,200 during the following week. The number of workers upon short time, drawing part benefits, was 53,400, as compared with 54,692 on April 3rd.

The Motor and Motor-cycle Exhibitions.—It is announced by the Society of Motor Manufacturers & Traders that the next Motor Exhibition will be held at Olympia from November 22nd to December 1st. Commercial vehicles and road-construction machinery will be included in this year's show. The Motor-cycle and Cycle Show will be held from October 15th to 20th, at Olympia.

German Trade during March.—In a review of the conditions of German industry during March, Mr. J. W. F. Thelwall, the Commercial Secretary at Berlin, states that imports of coal increased, and the combination of an improvement of the mark with a decline in the internal demand, restricted production in several branches, notably the machine industry. The electro-technical industry suffered from lack of orders. An ample demand for electrical plant of all kinds existed, but there was nowhere any possibility of raising the requisite capital. Foreign trade was very depressed, and sales of electric lamps again declined considerably. In general, employment in the electro-technical industry is assured for some months ahead, but restriction of work in individual cases is, however, not to be avoided. Prices have decreased somewhat.

Steam Plant for Japan.—The American Commercial Attaché at Tokio, quoted by *Commerce Reports*, states that the exceptionally dry winter has shown the hydro-electric companies of Japan that their plant is inadequate to meet the demand at all times without auxiliary steam equipment. The construction of reservoirs requires more capital than can be raised at the present time. Examples are given of a number of companies which have had to close down stations or portions of their plant, including the Osaka Electric Light Co., whose generating capacity has been reduced from 9,000 to 3,000 kW. Shortage of water has become an annual problem, as the Japanese streams are short and the seasonal flow in any circumstances shows wide limits of variation.

United States Electrical Exports.—According to *Commerce Reports*, the preliminary figures relating to the export of American electrical goods during January show a total of $6,400,943, comparing with $4,813,744 in January, 1922, and $5,836,391 in December, 1923. Increases occurred in the export of turbines, d.c. apparatus, self-contained lighting sets, and storage batteries, but the values of exported a.c. generators, transformers, and motors decreased. Domestic labour-saving, heating and cooking appliances remained at about the same level as in December.

Stoker Contracts.—Among recent sales effected by the Underfeed Stoker Co., Ltd., are the following:—

Travelling Grate Stokers.—Salford Corporation (9), Barking Power Station (10), Newport (Mon.) Electricity Department (2), St. Helens Corporation (2), Folkestone Electricity Co. (2), Londonderry Electricity Works (2), Samba-Mura power plant, Japan (4).

Underfeed Stokers.—Swansea Corporation Electricity Works (2).

Arches.—Hull, Eastbourne, Hammersmith, Brighton, and St. Helens electricity departments.

Belgian Companies.—The Société Anonyme Tramways de Turin, a Belgian company (54, Rue de Namur, Brussels), has parted with its undertaking to the city of Turin for three sums, to be paid yearly, of 1,300,000, 50,000, and 780,000 lire.

The Société Intercommunale Belge d'Electricité of Brussels, has just raised its capital to 42,000,000 fr.

The Société Anonyme Manufactures de Câbles Electriques et de Caoutchouc, of Eupon, has raised its capital to 12,000,000 fr.

E.D.A. Activities.—From the British Electric Development Association we have received a number of publications, old and new, all of which possess the qualities of interest and soundness. They deal with all phases of electrical development—domestic, public, industrial, and commercial. One of the most useful is E.D.A. No. 342, a booklet containing abstracts from a paper read by Mr. J. W. Beauchamp at one of the London salesmanship conferences, dealing with the competition between electricity and other lighting, heating, and motive agents.

Cost Accountants' Examinations.—The Institute of Cost and Works Accountants announces that its sessional examinations take place on June 4th, 5th, and 6th, and will be held in London, Manchester, Birmingham, Sheffield, Glasgow, and Bristol.

Dutch Wire and Cable Works.—The directors of the Holland Wire & Cable Works Co. report that sale prices were depressed below a remunerative basis in 1922, as in the previous year, owing to the low level of the mark. In the case of conductors the demand in the markets declined in consequence of the reduced activity in the building trades, and it was only possible to keep the turnover on an equality with that in 1921 by seeking new foreign markets, where it was necessary to hold stocks. The final result was that it had been possible to meet the general expenses out of revenue, but the provision for ordinary depreciation had to be made by an appropriation from the reserve fund.

Capital Increases in Germany.—The three water-power companies owned by the State of Bavaria have just approved their accounts for 1922-23. The first—the Bayern Works—has decided to raise the share capital from 800 to 1,600 millions of marks; the Central Isar Co., from 800 to 1,600 millions; and the Walchensee Works, from 400 to 800 millions of marks. In the case of the Bayern Works a length of 312 miles of overhead 100,000-volt line has already been erected on 3,600 masts. The Bavarian Electricity Supply Co., which belongs to the A.E.G. group, has resolved to increase the share capital by 40 to 130 millions of marks for the extension of the Bayreuth works. In addition, the Wurtemberg Power Works Co., of Heilbronn, which is associated with the Lahmeyer group, is to make an augmentation of 350 millions to 800 millions of marks; while the increase in the case of the old Wurtemberg Power Works Co. is 12 to 52 millions of marks.

Lead.—Under date April 21st, Messrs. James Forster and Co. state: "Demand from consumers has been quiet and of a 'hand-to-mouth' nature, though we believe that some consumers have orders in hand but are deferring purchases owing to the weak state of the market. On the other hand, we understand that orders for cables have fallen off considerably during the last month or so, owing, no doubt, to the high level of prices of copper and lead. Supplies of lead are ample: over 11,000 tons have arrived in London and Liverpool already during this month, in addition to which there is a large parcel of Mexican lead due in London at the end of next week."

Foreign Exhibitions.—Belgium.—The Department of Overseas Trade points out that many opportunities will be open to British manufacturers at the Ghent Electrical Exhibition, which is being held from June 16th to September 16th. The Oostflanders County Council has adopted a scheme for the distribution of electricity throughout the communes of the district, which will greatly increase the use of electrically-driven machinery, and will give a great impulse to *l'industrie à domicile, viz.*, weaving in the homes of the workpeople. The Belgian public is also enthusiastic regarding radio-telephony. The Secretary is anxious to secure British participation and is willing to place 1,350 sq. m. at the disposal of a suitable British association or syndicate, the estimated cost being 40,000 fr.

France.—It is announced that the French Colonial Exhibition, which was to have been held in 1925, is now likely to be postponed, as it is impossible to complete the extensive preparations which will be necessary by this date.—*Reuter's Trade Service* (Paris).

The Office Commercial Français pour la Grande Bretagne, 153, Queen Victoria Street, E.C.4, informs us that the Foire de Paris (15th National Samples Fair), to be held in the city from May 10th to 25th, will be on a much larger scale than previous fairs. There will be a large section specially devoted to the electrical trades. Our correspondents state that they will be glad to give all possible information to intending visitors.

LIGHTING AND POWER NOTES.

Ashby Woulds.—Electricity Supply.—The Urban Council has sanctioned an application by the Midland Counties Electrical Supply Co. for power to lay mains in the Council's area.

Ashford (Kent).—Electricity Supply.—The Urban Council has received from the Electricity Commissioners an intimation that they are satisfied that a supply of electricity in bulk cannot be obtained on reasonable terms from Canterbury or Maidstone, adding that the Urban Council will have to erect its own generating station.

Australia.—Newcastle (N.S.W.).—The accounts of the municipal electricity undertaking (engineer: Mr. Guy Allbut) show a total revenue of £107,026, as compared with £100,238; and a total expenditure of £92,464, as against £86,246; leaving a gross profit of £14,562 (£13,992). After the payment of capital charges a net surplus of £10,339 remained, as against £10,128. There was a slight decrease in the amount of energy sold from 14,793,597 to 14,719,537. It is of interest to note that there has been no alteration in charges to consumers between the years 1910 and 1922 inclusive.

New South Wales.—The Melbourne *Age* states that the development of water power is to take an important place in the schemes planned by the new Government. The Premier recently stated that experts computed that a total of 412,600 h.p. was available from 53 streams and storages. Snowy River could provide 150,000 h.p. and the Clarence River 100,000 h.p.

The Minister for Works recently said that the tenders had been received for the plant, &c., required in connection with the Burrinjuck hydro-electric scheme. It is proposed to erect auxiliary stations at Gilmore Creek and Buddong Falls, which will be "tied in" with Burrinjuck. The capacity of the three stations will be over 12,000 kW, whereas Burrinjuck alone will only produce 5,000 kW. The distribution system is to be so arranged that an alternative route will be provided in case of a breakdown.

Sydney (N.S.W.).—The total net profit from the municipal electricity undertaking for the year ended December 31st last was £141,353. After deducting a deficit of £23,747 brought forward, the balance was allocated as follows:—Demolition of buildings, £24,335; relief of rates, £35,500; renewals reserve account, £57,000; carried forward, £2,770.

Melbourne (Vic.).—The municipal electricity undertaking earned a total revenue of £403,750 during 1922, an increase of £47,304 over that of the previous year. Working expenses increased by £8,971 to £243,626, leaving a gross profit of £160,124—an increase of £58,333. After providing for interest, depreciation, sinking fund, superannuation, capital expenditure out of revenue, &c., a net profit balance of £40,755 remained.

Basingstoke.—Year's Working.—The report of the municipal electrical engineer (Mr. F. Swarbrick) for the year ended March 31st last states that the total income was £12,760, as against £11,443 in 1921-22. The net result was a profit of £2,220. The number of kWh sold increased by 85,878 to 611,730. The capital expenditure during the year was £2,421, chiefly for mains, services, and meters. This station, according to the report of the Electricity Commissioners for 1922, has the next to highest thermal efficiency for its group size in the whole of Great Britain, and takes the first place in its allocated area.

Brentwood.—Special Order.—The Electricity Commissioners have granted a special Order to the Brentwood District Electric Co., Ltd., for the supply of electricity to Brentwood and portions of the parishes of Hutton, Ingrave, Shenfield, and South Weald, and the rural district of Billericay.

Continental.—Russia.—Work on the construction of the Volkhov station is reported to be making progress, although the station will not be completed for a long time to come. It will then be able, according to existing intentions, to supply 80,000 kW to Petrograd. If the programme of development of the industries in Petrograd in the next five years should be realised, it is calculated that the supply of energy which will then be available will be inadequate to meet the demand. As a consequence, the question has been raised of resuming the works in connection with the Svir station, which were undertaken between 1918 and 1920, and then brought to a standstill. A new scheme for the execution of the works has been suggested, under which three stations would be erected at an estimated expenditure of 111,000,000 gold roubles.

Germany.—According to the *Frankfurter Zeitung*, the first aim of the newly-formed Rhine-Main-Danube Co. will be the development of the waters of the Danube at Kachlit, near Passau. This station will be completed in four years, and will have a capacity of 56,000 h.p.

Italy.—The Società Italiana Ernesto De Angeli, of Milan, has secured a concession to develop 8,577 h.p. from two waterfalls and to erect two power stations on the River Serio in the province of Bergamo. A concession to generate 2,502 h.p. from the same river has also been granted to the Società Anonima Industrie Riunite di Filati, of Bergamo, a station being built at each of the two intakes.

Other water concessions are to the Società Marchigiana di Elettricità, of Recanati (3,784 h.p.); the Società Unione Esercizi Elettrici, province of Pesaro (1,712 h.p.); the Società Anonima Idroelettrica Rivallese, province of Potenza (5,000 h.p.); and the Consorzio Intercomunale Destra Piave Nervesa, province of Treviso (2,652 h.p.), from two waterfalls on the Piave River.

Coventry.—New Plant.—The Electricity Committee has recommended to the Town Council that additional plant be provided at the Sandy Lane generating station, at a cost of £29,842.

Edinburgh.—Inauguration of Portobello Station.—It is proposed that the formal opening ceremony in connection with the new power station at Portobello shall take place in July.

Finchley.—Loan Sanctioned.—The Urban District Council has received the sanction of the Electricity Commissioners to a loan of £7,350 for mains and plant in connection with the linking-up with Hornsey.

Harwich.—Electricity Scheme.—The Town Council has received a report from its consulting engineer on the proposed electricity scheme for the borough. The London and North-Eastern Railway Co. is being approached for the terms on which it would be prepared to give a supply of electricity in

bulk, and application is to be made to the Electricity Commissioners for sanction to the borrowing of £23,299 for carrying out the scheme.

Haslington.—Electricity Supply.—At a recent meeting of ratepayers, a resolution was passed in favour of an electric lighting scheme, subject to satisfactory terms being arrived at with the Crewe Corporation. It is proposed to erect an overhead cable from Sydney at a cost of £1,600. The Crewe Corporation requires a guarantee of 100 consumers.

Horwich.—Inquiry.—On April 17th, Col. E. T. Ekin, on behalf of the Electricity Commissioners, held an inquiry into the rival applications made by the Urban District Council and the Lancashire Electric Power Co., Ltd., for an Order to supply electricity in the district. Mr. Sutcliffe, for the Council, said that although the company had had powers to supply in the district since 1900, nothing had been done. Alternative quotations had been obtained from the company and Bolton Corporation, and the latter's terms were the more advantageous. Moreover, the South-East Lancs. Electricity Advisory Board had recommended a supply from Bolton. Mr. W. J. H. Wood, the Bolton electrical engineer, estimated that there was an immediate demand in the district for 500 kW; the Bolton Corporation already ran tramways in the district. The estimated cost of a scheme was £16,563, and the charges would be 6d. per kWh for lighting and 2d. per domestic power, falling by a sliding scale to 1d. per kWh.

Mr. Craig Henderson, K.C., for the company, said that his clients already possessed the right to supply power users in the district, and suggested that it would not be worth while to make a Special Order merely for lighting.

The Advisory Board did not recommend the annulment of the company's existing powers, nor did it wish to prejudice the Council's case. After evidence had been given by residents, the inquiry was closed.

Leigh (Lancs.).—Change Over.—The Electricity Committee has approved a scheme for changing the system of supply in the Pennington, Twist Lane, Firs Lane, and Plank Lane districts from direct to alternating current at an estimated cost of £3,900.

London.—St. Pancras.—The London, Midland and Scottish Railway Co. has asked the Council for its consent to supply electricity for lighting and power purposes to King's Cross station. As the station is in the Council's area, and it is possible for the Council to meet the requirements, the Electricity and Public Lighting Committee recommends that permission be refused.

Maesteg.—Special Order.—The Urban District Council has applied to the Electricity Commissioners for authority to supply electricity in the district. It is proposed to obtain a bulk supply from North's Navigation Collieries (1889), Ltd.

Mersey and West Lancs. Electricity District.—Draft Order of Constitution.—The Electricity Commissioners have issued a draft Order which provides for the constitution of the Mersey and West Lancashire Electricity District, for the establishment and incorporation of the Mersey and West Lancashire Joint Electricity Authority, and for the establishment and incorporation of the Wirral Electricity Joint Board. They intend to hold a local inquiry at the Town Hall, Liverpool, on May 15th, 1923, with reference to the aforesaid Order, and in order finally to determine the area of the proposed district.

North Wales and Chester Electricity District.—Exclusion of Chester.—With reference to the evidence given at the local inquiry at Llandudno in November last into the draft Order embodying the scheme which the Electricity Commissioners propose to approve for the above-named district, Mr. S. E. Britton, city electrical engineer, Chester, has been informed by the Electricity Commissioners that, after taking further advice upon the legal questions raised during the course of the representations that were made on behalf of the Corporation of Chester, they are proceeding with the settlement of the draft Order. The Commissioners have decided, however, to exclude from the district the areas of supply covered by the Chester Electric Lighting Order, 1890, and the Chester Electricity (Extension) Special Order, 1923, and to make the necessary consequential excisions from the draft Order.

Norwich.—Loan.—The Town Council is applying to the Electricity Commissioners for sanction to the borrowing of £3,500 for mains. Application is also being made for authority to increase the maximum charge for electricity to 10d. per kWh.

Preston.—New Sub-stations.—The Electricity Committee has recommended the erection of sub-stations at Dock and Ribbleton, the laying of mains, and that application be made to the Electricity Commissioners for sanction to the borrowing of £19,300 for these purposes.

Price Reductions.—Weybridge. (Urban Electric Supply Co., Ltd.). Lighting: First 50 kWh per quarter, 11d. per kWh; next 50, 10½d.; next 50, 10d.; next 50, 9½d.; over 200 kWh, 9d. per kWh.

Twickenham (Twickenham and Teddington Electric Supply Co., Ltd.).—Lighting: First 50 kWh per quarter, 11d. per kWh, falling by ½d. per kWh for each 50 kWh up to 200; over 200 kWh, 9d. Heating: First 100 kWh per quarter, 4½d. per kWh; in excess of 100 kWh, 3d. per kWh. Contract tariff: "Unit" charge reduced from 3½d. to 3d. Power: First 100 kWh, 7d. per kWh; next 3,000, 3½d.; next 30,000, 3d.; over 33,100, 2½d.

Melton Mowbray (Electric Light Co., Ltd.)—Lighting: Flat rate, for all energy used in excess of minima (15 kWh for winter quarters and 10 kWh for summer quarters, at 1s. per kWh), for the first 100 kWh per quarter in excess, 10d. per kWh; above 100, 2½d. Contract tariff: "Unit" charge, for the first 100 kWh per quarter, 3½d. per kWh; above, 2½d. per kWh. Power; First 100 kWh, 6d. per kWh; next 3,000, 3½d.; next 15,000, 2½d.; over 18,100, 2d. Heating: First 100 kWh, 3½d. per kWh; above, 2½d.

Atherton.—Lighting: a reduction of 1d. per kWh. Power: from 1d. to ½d. per kWh.

Barnes—Lighting: 4½d. per kWh. Contract tariff: 3d. per 20-W lamp per week.

Burnley.—Lighting: from 5½d. to 5¼d. per kWh. Power: a reduction of 2d. per kWh for each stage in the scale of charges. Heating and domestic appliances: from 2.4d. to 2d. per kWh. Charges outside the borough: Lighting, from 6½d. to 6¼d. per kWh; heating and domestic appliances, from 3.4d. to 3d. per kWh.

Colchester.—Lighting: 8d. per kWh, less 2½ per cent. Power: Small power consumers, first 50 kWh per quarter, 4½d. per kWh.; next 50 kWh, 3½d. per kWh; next 50 kWh, 3d. per kWh, less 2½ per cent.; large power consumers: first 2,500 kWh per quarter, 2½d. per kWh, less 2½ per cent.; next 2,500 kWh, 2½d. per kWh net; beyond, 2d. per kWh net. Long-period combined rate for power and lighting: over 50,000 kWh per annum, 2d. per kWh.

Radcliffe.—New Plant.—The District Council has received a report from its electrical engineer on the disposal of plant at the electricity works, and of the purchase of additional converting plant. The engineer has been instructed to prepare a specification for the installation of a 1,000-kW rotary converter with switchgear.

Rugby.—Electricity Supply.—The Urban Council has agreed to take a supply of electricity for a period of 10 years, from October next, from the Warwickshire and Leicestershire Power Co.

Southend-on-Sea.—Loans Sanctioned.—The Town Council has received sanction to a loan of £35,000 for the purchase of three 750-kW Diesel sets, with accessories, &c., and to a loan of £15,779, balance of capital expenditure in respect of the provision of Diesel engines at the main station and the Leigh and Thorpe Bay sub-stations, and for the erection of a condenser, &c.

Stratford-on-Avon.—Electricity Order.—The Barford Electric Supply Co. is applying to the Electricity Commissioners for an Order authorising it to supply electricity in the villages of Wellesbourne, Charlecote, Alveston and Tiddington.

Sunderland.—Electricity Supply for Workhouse.—The Board of Guardians has decided to install electricity at the workhouse for lighting and power purposes. The estimated cost of the scheme is £3,500.

Taunton.—Loan.—The Town Council is applying to the Electricity Commissioners for sanction to the borrowing of £2,250 for the installation of a new boiler at the electricity works.

Torquay.—Loan Sanctioned.—The Town Council has received the sanction of the Electricity Commissioners to the borrowing of £13,500 for new plant at the main sub-station.

United States.—Pit River Development.—Work on the construction of the second of a chain of power stations which will ultimately develop over 600,000 h.p. from the Pit River, in Northern California, will be commenced shortly. The plant will include three generating sets each of 27,000 kVA capacity, and it is estimated will cost $17,000,000. It will be situated about 12 miles below the first power station.—*Power.*

A Large Frequency Changer.—The Westinghouse Electric and Manufacturing Company has recently supplied a 35,000-kVA frequency changer to the Brooklyn Edison Company for installation in the latter's Gold Street station.

Walmer.—Electricity Order.—Sir Charles Bright & Partners have applied to the Electricity Commissioners for an Order authorising them to supply electricity to Deal, Sandwich, Walmer, and in the area of Eastry Rural Council.

Walsall.—Loan.—The Town Council is applying to the Electricity Commissioners for sanction to borrow £4,900 for the completion of the generating station, for which a total expenditure of £129,500 has already been sanctioned.

Walton-le-Dale.—Electricity Supply.—The Preston Corporation will furnish a supply of electricity to the district on the completion of Preston and Blackburn mains.

Warrington.—New Plant.—The new set which has just been put in service by the Warrington Corporation is the first of two 7,000-kW (not 6,000-kW as stated in our last issue) Brush-Ljungström turbo-alternators, ordered in December, 1920. It is anticipated that the second set will be started up in the autumn of this year. The condensing water for the plant is drawn from the River Mersey, where there is an ample supply of water for such purposes. River intake and screens were erected on the banks of the river, which communicate through pipes with a pump chamber, over which have been erected two motor-driven centrifugal pumps of

9,500 g.p.m. capacity, with provision for a third when required. Additions are being made to the high-pressure switchboard, and the older d.c. and traction switchboards are being moved from the engine room to a new switchroom. The second set will be installed in the existing engine room, after the removal of obsolete plant, occupying the same space as two 250-kW reciprocating sets. The mains are being rapidly extended in the districts surrounding the borough. A considerable demand is springing up in these districts, not only for lighting, but for heating and cooking purposes. With a revival in trade, large applications are being received from manufacturers for current for power purposes. The turbine is of the axial flow double rotation type, designed for a steam pressure of 175 lb. per sq. in. at the turbine stop valve, superheated to a total temperature of 650 deg. F., and running at a speed of 3,000 r.p.m. The turbine is coupled direct to two Brush-Ljungström alternators, each designed for a 3-phase output of 3,500 kilowatts, at 50 periods, 6,600 volts.

The turbo-alternator set is mounted direct on a Brush surface condenser, which has a cooling surface of 11,000 sq. ft., and is capable of dealing with 69,500 lb. of exhaust steam per hour, and maintaining a vacuum of 28½ inches (barometer 30 inches) when supplied with 8,500 gallons of water per minute at a temperature not exceeding 65 deg. F. The auxiliary plant for the condenser consists of a Delas steam jet ejector of the two-stage type, with water-cooled jackets. The water extraction pump is of the centrifugal type, and is driven by a Brush 8 h.p. squirrel-cage induction motor. To maintain the oil supply in the event of the main oil pump failing, a Worthington-Simpson horizontal auxiliary oil pump is provided, and arranged to come into action automatically in the event of failure of the main oil pump. The oil is filtered continuously through a Fox patent oil filter and water separator. The cooling air for the alternators is filtered by means of a Cleworth Wheal air filter, having a capacity of 24,000 cu. ft. of air per minute. The cooling air is supplied by a motor-driven Standard and Oswold Stott fan.

Wells (Somerset).—Electricity Supply.—The Town Council has decided to provide an electricity supply for the town, and a contract has been entered into with Messrs. Sanders, Kennedy & Co., of Burnham-on-Sea, to carry out the scheme.

TRAMWAY AND RAILWAY NOTES.

Continental.—Belgium.—The Société des Tramways Electriques de Gand has recently completed negotiations with the municipal authorities of Ghent for the extension of several of its lines in the town and suburbs.

Poland.—A new electric railway company has been formed, which will construct in the first place a line between Warsaw, Grodzisk, and Zyrardow, and a line from Warsaw to Wolomine to connect the suburbs with the capital. The new concern inaugurates the co-operation of British and Polish capital. The power will be supplied by the Pruszkow electricity works.—*Reuter's Trade Service* (Warsaw).

Italy.—The Government has allotted the construction of the proposed Garganica railway to private enterprise, aided by a yearly subsidy. The construction of the new electric tramway from Modena to San Damaso by the municipality of Modena has been officially sanctioned.

France.—*Hungarian Locomotives.*—The Ganz-Danubiens-Maschinen-Fabrik has received a trial order from the Compagnie d'Orleans for two electric locomotives.—*Reuter's Trade Service* (Budapest).

Canada.—Montreal.—The president of the Montreal Tramways Co. recently stated that it was the intention of the company to expend $2,000,000 upon repairs, renewals, and extensions during the present year.

Huddersfield.—Track Renewals.—The Tramways Committee has instructed the borough engineer to proceed with the reconstruction of the existing tracks in Northgate and Viaduct Street, and has decided to defer the doubling of the lines in Bradford Road until Parliamentary powers for the road widening have been secured.

Tramway Receipts.—The Tramways Committee reported last week that the new tramway route to Brighouse recorded, for the first 37 days, 199,846 passengers, and the receipts were 28.28d. per car mile, which exceeded the average for the other routes of the Huddersfield tramways.

India.—Proposed New Tramway.—The United Provinces Forest Board has approved the scheme of the construction of a tramway up the Kosi valley from Ramnagar to Garjia, and considers that the R. K. Railway should be approached to ascertain the possibility of the company's building a 2½-ft. or 2-ft. gauge line.—*Reuter's Trade Service* (Bombay).

Leeds.—Year's Working.—The 1922-23 accounts of the tramways undertaking (general manager: Mr. J. B. Hamilton) show a total revenue of £961,508, as compared with £959,703 in the previous year. Working expenses amounted to £599,982 (£702,250), leaving a gross profit of £361,526 (£257,452). After deduction of interest, income tax, &c., there was a net surplus of £91,491. In the previous year there was a deficit of £43,266. The number of passengers carried was 134,926,024, an increase of over five millions, and the number of car miles run was 9,875,548. The receipts per car mile were 23.367d.

London.—Season Tickets.—The London Electric Railway Co. is to introduce season tickets which will be available on the underground railways, trams, and 'buses. An experiment is to be made at Golders Green station, from which monthly or quarterly tickets will be issued which will enable passengers to complete the journey to Barnet and Finchley either by tram or 'bus.

Yarmouth.—Loan Sanctioned.—The Town Council has received the sanction of the Ministry of Transport to the borrowing of £58,194 for track renewals.

TELEGRAPH & TELEPHONE NOTES.

Russia.—Telegraphic Communication.—It is announced by *The Times* that the telegraph line between Moscow and Vladivostok has been restored.

Spain.—Swedish Telephone Concession.—As reports had been circulated in Stockholm to the effect that the Ericsson Telephone Co. contemplated an extension of its foreign organisation, an inquiry by a local newspaper as to the facts resulted in the manager intimating that the company has acquired a telephone concession for the town and district of Valencia, Spain. The company formed a Spanish company for this purpose some time ago with a share capital of 1,000,000 pesetas, and it was then possible to enter more into official negotiations on the matter, these having now led to the company taking over the concession for the town network. It is, however, not proposed to carry on any manufacturing in Spain, and all the equipment will be supplied either from Sweden or from subsidiaries of the parent company.

The Telephone Service.—Rural and Party Lines.—A deputation from the Central Chamber of Agriculture waited upon the Postmaster-General (Sir William Joynson-Hicks) on April 18th to lay before him the suggestions made by the Parcel Post and Rural Telephone Committee appointed by the Chamber.

The Postmaster-General agreed with all that had been said regarding the necessity for rural telephones and wanted just as much as the deputation to extend their usefulness. He was going to make a personal appeal to the railway companies as a whole, to see whether they could allow call boxes to be put in all stations throughout the country. The Post Office was extending the facilities for call boxes throughout the country. Out of 13,478 post offices, 4,965 were equipped with public call offices; and of the remaining 8,513 offices, 2,307 were telegraph offices without call offices, and the balance of 6,206 had neither telegraph nor call office facilities. Last year they provided 538 call offices in rural districts, and he saw no reason why they should not add a similar number this year. The party wire system was not altogether satisfactory, and they were experimenting in the hope of being able to arrange in a year or two for rural party lines to have some means of ensuring privacy.—*The Times.*

RADIO-TELEGRAPHY AND TELEPHONY.

Argentina.—Radio Concession.—The original concession granted on March 15th, 1919, to Siemens-Schuckert, Ltd., for the operation of a high-power radio station in Buenos Aires, has been modified to meet the changed conditions resulting from the consolidation of American, French, English, and German interests in the Argentine Radio Telegraphic Co. Transradio S. A. The period of the concession is extended to 50 years, and the Argentine Radio Telegraphic Co. Transradio S. A. is authorised to communicate with points distant more than 1,000 kilometres from Buenos Aires, with the exception of those with which the nation has its own telegraphic communication; but if the nation shall so request, the company is obliged to establish its service also to such points. The concessionaire is subject to the provisions of the International Radiotelegraph Convention, and the rates to be charged shall be less than the equivalent of two-thirds of the telegraph rates in force between the points served. The company shall pay to the nation 1 per cent. of the tolls for each word transmitted, relayed, and received. (It is possible that operation of this service may come under the jurisdiction of the radio regulatory board recently appointed by the President.)—*Commerce Reports.*

Broadcasting.—The London station of the British Broadcasting Co., Ltd., is to be removed from Marconi House, in the Strand, and the company is busily engaged in the construction of a sound-proof room at its offices on Savoy Hill, which will be used for sending out the wireless programmes. The room is expected to be ready on May 1st. It is larger than the present one in use at Marconi House, thus enabling more elaborate programmes to be given.

The Broadcasting Co. has been carrying out experiments with a view to transmitting signals from a central studio in London to the different stations. It declares that it is not as yet satisfied with the results obtained; but some listeners-in have declared that the Birmingham and Glasgow items which came through to London and were radiated from 2LO were even an improvement on 2LO.

Denmark.—Long-distance Radio-telephony.—The Danish Government has arranged to open what is stated to be the longest regular radio telephone service linked with line services in the world, between Lyngby, near Copenhagen, and the island of Bornholm in the Baltic, a distance of 93 miles.—*Daily Mail.*

Greenland.—New Radio Station.—The Danish Home Minister, M. Kragh, introduced to the Folketing Finance Committee on April 18th a plan for the erection of a radio station at the most southerly point of Greenland at an estimated cost of half a million kronor.—*Financial News.*

Irish Free State.—Radio Broadcasting.—The Irish Free State Postmaster-General (Mr. J. J. Walsh) some days ago stated that he hoped shortly to be in a position to grant licences for the establishment of radio broadcasting stations in the Free State. Firms and persons interested in the manufacture and supply of broadcasting apparatus are invited to apply to the Secretary, G.P.O., Dublin, so that arrangements may be considered and preparations be made in good time.

Japan.—Broadcasting.—The Japanese Government has relaxed its hold on one division of communications to a limited extent, and private concerns will be permitted to broadcast by wireless. For the present only three or four financially sound companies in the larger cities will be licensed. They will be required to pay a tax, and will be permitted to collect for their service direct from subscribers. The Government will charge users a yearly registration fee, and pay a part of this to the broadcasting companies. The Ministry regulations for using radio sets were to take effect on April 1st.—*Commerce Reports.*

Manila.—Telegraph and Telephone Developments.—A sum of 120,000 dollars has been appropriated by the Manila, P. I., authorities for the improvement of the telegraph and telephone systems in those islands, and $75,000 for the radio stations and equipment.—*T. & T. Age.*

Radio Telephones on Lightships.—Steps are being taken to displace the radio telegraph installations in some of the lightships off the Thames Estuary by radio telephone sets in order to improve the facilities for communicating with the land in cases of ships in distress. The North Goodwins lightship is the first to be fitted with the telephone. The lightship will inform the land station at Ramsgate what help is needed, and the land lines will then be used to communicate with whichever lifeboat station is nearest to the lightship concerned.—*The Times.*

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Amble.—May 1st. Urban District Council. Pole line, transformers and switchgear. (April 13th.)

Atherton. — Supply, &c., of electrical organ-blowing equipment, complete with switchgear, for Atherton Baptist Church. Mr. W. F. Benson, Brookland House, Leigh Road, Leigh.

Australia.—Melbourne.—August 31st. Victorian Electricity Commission. 500 miles of .0707 sq. in. aluminium steel-cored cable.

July 31st. Electricity Commissioners. Electrically-operated power shovel. (April 20th.)

June 12th. Postmaster-General's Department. Power plant.*

June 5th. City Council. 6,600-V switchgear for sub-stations.—*Reuter's Trade Service* (Melbourne).

Brisbane.—June 5th. Public Works Department. Three motor-driven pumps.

October 31st. City Electric Light Co. One 12,500-kW turbo-alternator unit at Bulima, Brisbane.—*Reuter's Trade Service* (Melbourne).

Sydney.—June 21st. Postmaster-General's Department. Telephone switchboard wire and switchboard and multiple twin underground cable.*

June 11th. City Council. 10,000-V earthing reactance and resistances.—*Reuter's Trade Service* (Melbourne).

Argentina.—Buenos Aires.—June 4th. Department of Navigation and Ports. Machine tools, electric motors, pumps, electric battery trucks, ceiling, wall, and table fans.*

Belfast.—May 7th. Electricity Department. One 1,000-kW and one 1,500-kW rotary converters, with transformers, switchgear, &c. (April 20th.)

Belgium.—June 15th. Belgian Third Direction Générale du Ministère de la Défense Nationale, 10, Rue du Méridien, Brussels. Dry and other batteries required for the telegraph section of the Belgian Army.

May 15th. Municipal authorities of Heusden (Province of Limbourg). Establishment of a system of l.p. electricity supply in the town.

Bradford.—June 7th. Electricity Department. One 15,000/20,000-kW turbo-generator, &c. (without condensing plant). (See this issue.)

Chelmsford.—Messrs. Christy Bros. & Co. are inviting quotations for 400 30/32-ft. steel poles, with cross arms and fittings, also 200 creosoted wood poles. (See this issue.)

Dublin.—April 30th. Electricity and Public Lighting Committee. Single-phase and three-phase meters and slot meters for one year. Town Clerk (John J. Murphy), Fleet Street offices, Dublin.

April 30th. Magazine flame arc lamps. City electrical engineer, Fleet Street, Dublin.

Edinburgh.—May 15th. Electricity Supply Department. Underground insulated cables for 12 months. (See this issue.)

Glasgow.—April 30th. Electricity Department. Cables, meters and carbons for 12 months. (April 13th.)

May 3rd. Lighting Department. Materials for one year from June 1st next, including electrical fittings and accessories, &c. Office of department, 20, Trongate.

Grimsby.—April 28th. Electricity Department. Substation 6,600/6,600-V switchgear and five transformers, with capacities up to 100 kVA. (April 13th.)

Harrogate.—April 30th. Electricity Department. H.p. or e.h.p. switchboard for single-phase a.c. (April 20th.)

Hull.—City and County Telephone Committee. Table telephone instruments, rubber-covered wire, and dry cells. (April 13th.)

Ilford.—May 8th. Electricity Works. 500-kW converting plant. (April 20th.)

Kirkcaldy.—May 1st. Electricity Works. H. and l.p. feeder cables and cooling tower. (April 13th.)

Limerick.—May 5th. County Board of Health. Installation of electric lighting at the County Hospital at Croom. Mr. Patrick J. Sheehan, architect, Limerick.

London.—Paddington.—May 14th. G.W. Railway Co. Stores for 6 months, including telegraph instruments, electrical apparatus, wires and cables, &c. (See this issue.)

Manchester.—May 4th. Electricity Department. L.p. pipework, &c. (April 20th.)

May 8th. Tramways Committee. Three one-man operated motor-buses complete. Mr. H. Mattinson, general manager, Corporation Tramways, 55, Piccadilly, Manchester.

New Zealand.—Wellington.—May 22nd. Post and Telegraph Department. Wall and desk C.B. telephones.*

June 12th. Public Works Department. Electric storage battery and accessories.*

June 26th. Switchgear for the Waikato power house.

Napier.—Borough Council. One 500-kVA generator and exciter set. Hay, Vickerman & Lancaster, Ltd., Wellington, N.Z.*

Nottingham.—Corporation. Two 4-ton electric vehicles for the collection of house refuse. (See this issue.)

Poole.—May 28th. Town Council. Electrical installation, waterworks pumping station, Corfe Mullen. Mr. A. P. I. Cotterell, engineer, 17, Old Queen Street, Westminster, London, S.W.1.

Preston.—Electricity Committee. Two 500-kW rotary converters, with transformers and switchgear. E.h.p. and l.p. paper-insulated cable. Borough electrical engineer, 118, Fishergate, Preston.

Reigate.—April 30th. Electricity Department. Transformers and switchgear. (April 13th.)

Southampton. — April 30th. Electricity Department. E.h.p. cables and switchgear. (April 20th.)

Spain.—The municipal authorities of Manresa have invited tenders for the concession for the electric lighting of the town during a period of 12 years.

St. Johnston (Co. Donegal).—June 1st. Installation of an electric lighting plant in the church. Rev. D. Watson, St. Johnston.

Sweden.—Norrkoping.—May 5th. Harbour Board. Three 4-ton and one 5 to 6-ton electric cranes.*

Uruguay.—Montevideo.—June 12th. State Electric Light Works. 42,000 metal-filament electric lamps.*

York.—May 10th. Electricity Department. One 1,000-kW motor generator and switchgear. (See this issue.)

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

CLOSED.

Australia.—The Sydney City Council, toward the end of February, placed a contract with Messrs. Siemens Bros., of London, for transformers at £14,118. An amendment, placing the order in Australia, was moved, but was defeated by 11 votes to 10. Labour aldermen, however, gave notice to move the rescission of the motion and the placing of the order with the English Electric Co., of Australia, Ltd., at £17,228 for manufacture at its Clyde workshops.

Sydney.—City Council. Recommended:—
Electric goods lift (£1,310).—Waygoods, Ltd.
Visco air filted for turbo-alternator (£616).—Visco Engineering Co., Ltd.

Melbourne.—City Council. Accepted:—
Four 2,000-amp. circuit breakers (£119).—Edison Swan Electric Co., Ltd.

Narrandera (N.S.W.).—Municipal Council. Accepted:—
One 100-kW and three 50-kW generators.—Crompton & Co.—*Tenders.*

Ballinasloe.—
Electrical installation at Garballey Court.—Roche & Majennis.—*Irish Builder and Engineer.*

Barking.—Messrs. A. Reyrolle & Co., Ltd., have secured the contract for the main switchboard for the Barking station of the County of London Electric Supply Co., Ltd.

Belgium.—The municipal authorities of Clavier recently invited tenders for the supply of electrical energy to the village of Pair. The only offer received was that of the Société de l'Electricité de Seraing et Extensions.

Congratulations to the British Insulated & Helsby Cables, Ltd., on receiving the order for cables for the municipality of St. Gilles, Brussels. As stated in our last issue, they quoted lower than four Belgian concerns, also one Dutch and one French.

Burton-on-Trent.—Town Council. Accepted:—
Relaying l.p. mains in High Street and Station Street (£6,900).—Johnson and Phillips, Ltd.

Coventry.—City Council. Accepted:—
6,000-kW turbo-alternator (£29,842).—British Thomson-Houston Co., Ltd.

Lancaster.—Electricity Committee. Accepted:—
Rotary converter at Marton Street Works and rewinding alternators and supplying switchgear at Cator Road Works (£11,800).—Metropolitan-Vickers Electrical Co., Ltd.
E.h.p. switchgear for Cator Road Works (£1,500).—Ferguson, Pailin and Co., Ltd.
H.p. mains.—British Insulated & Helsby Cables, Ltd.
Boiler feed pump (£294).—G. & J. Weir, Ltd.

Leyton.—The District Council is recommended to authorise the sealing of the following contracts:—
Cable.—Union Cable Co., Ltd.
E.h.p. switchgear.—Reyrolle & Co., Ltd.
Motor converter.—Bruce Peebles & Co., Ltd.

Liverpool.—Mersey Docks and Harbour Board. Accepted:—
Electric cables.—Callender's Cable and Construction Co., Ltd.

Londonderry.—Electricity Department.
Boiler plant (£12,094).—Yarrow & Co., Ltd.—*Irish Builder and Engineer.*

London. — Stepney. — Electricity Supply Committee. Accepted:—
One barge (150 tons) Netherseal Beans, Bradbury, Son & Co. (1920), Ltd., 31s. 6d. per ton; 100 tons Nailstone D/S nuts, 33s. ton, Southern Fuel Co.; 130 tons Scotch nuts and slack, 30s. 6d. per ton, J. Hudson and Co., Ltd.; 1 barge Rossington 1-in. slack, 27s. 1d. per ton, Shipping and Coal Co., Ltd.; 150 tons Mansfield nutty slack, 28s. 6d. per ton, Denham Fawcus & Co.
Two tons sheet lead (£74).—Newcome & Co., Ltd.
Two tons plumbers' and ½ ton tinman's solder (£227).—G. W. Neale, Ltd.
Cast-iron strainer boxes for turbine at Limehouse generating station (£137).—Caird & Rayner.
Steel separators, steam piping, &c. (£1,147).—Foster Bros., Ltd.
Concrete foundations for Nos. 1 and 2 turbos at Limehouse generating station (£2,663).—Perry & Co.

L.C.C. Highways Committee. L.p. cables required in connection with the construction of the proposed tramways in Amhurst Park, &c.:—

A. Roberts & Co., Ltd.	£3,685
Enfield Ediswan Cable Works, Ltd. (Accepted)	3,758
Pirelli-General Cable Works, Ltd.	3,915
G. E. Taylor & Co.	4,010
The E.S. Co., Ltd.	4,044
National Electric Construction Co., Ltd.	4,181
Western Electric Co., Ltd.	4,234
Macintosh Cable Co., Ltd.	4,264
British Ins. and Helsby Cables, Ltd.	4,303
Siemens Bros. & Co., Ltd.	4,319
Johnson & Phillips, Ltd.	4,352
W. T. Glover & Co., Ltd.	4,370
Callender's Cable and Cons. Co., Ltd.	4,390
W. T. Henley's Tele. Works Co., Ltd.	4,427
Smith & Bellhouse	5,469

Battersea.—Electricity Undertaking Committee.
Switchgear (£645).—Park Royal Engineering Co., Ltd. (Recommended.)

Preston.—Electricity Committee. Accepted:—
Rotary converters, switchgear, &c., for two proposed sub-stations (£6,953).—English Electric Co., Ltd.
Supplying and laying mains (£7,338).—British Insulated and Helsby Cables, Ltd.

Shotts (Lanarkshire).—Messrs. Whyte, Thomson & Co. have secured the contract for the electric lighting of the new miners' institute.

Wicklow.—Urban Council. The following tenders have been accepted in connection with the electric lighting of the town:—
Engines and generators (£2,159).—Crossley Bros., Ltd.
Motor booster (£124).—Drake & Gorham, Ltd.
Battery and accumulators (£559).—Electric Storage Co.
Switchboard (£315).—Drake & Gorham, Ltd.
Overhead equipment (£1,889).—Irish Electric and Constitution Co.—*Irish Builder and Engineer.*

FORTHCOMING EVENTS.

Royal Society of Arts.—Monday, April 30th. At John Street, Adelphi, W.C. At 8 p.m. Howard Lecture, "The Development of the Steam Turbine," by Mr. S. S. Cook. (Lecture I.)

Roentgen Society.—Tuesday, May 1st. At the Institution of Electrical Engineers, Victoria Embankment, S.W. At 8.15 p.m. Ordinary meeting.

Institute of Metals.—Wednesday, May 2nd. At the Institution of Mechanical Engineers, Storey's Gate, S.W. At 8 p.m. Annual May Lecture, "The Inner Structure of Alloys," by Dr. W. Rosenhain, F.R.S.

Institution of Electrical Engineers (Wireless Section).—Wednesday, May 2nd. At the Institution, Victoria Embankment, W.C. At 6 p.m. "The Design of Inductances for High-Frequency Circuits," by Prof. C. L. Fortescue.

(East-Midland Sub-Centre).—Tuesday, May 1st. At Loughborough College. At 6.45 p.m. Paper on "An Electric Harmonic Analyser," by Prof. Miles Walker.

Chemical Society.—Thursday, May 3rd. At Burlington House, Piccadilly, W. At 8 p.m. Ordinary Scientific Meeting.

Royal Institution.—Thursday, May 3rd. At Albemarle Street, W. At 3 p.m. Lecture on "Modern Electric Lamps," by Prof. J. T. Macgregor-Morris. (Lecture II.)

Junior Institution of Engineers.—Friday, May 4th. At 39, Victoria Street, S.W. At 7.30 p.m. Lecturettte, "A.c. Neutral Point Earthing," by Mr. S. A. Stigant.

Institution of Civil Engineers.—Friday, May 4th. At the Institution, Great George Street, S.W. At 6 p.m. James Forrest Lecture, "The Interdependence of Abstract Science and Engineering," by Sir R. T. Glazebrook, F.R.S.

Edinburgh Electrical Society.—Friday, May 4th. At the Philosophical Institute. At 8 p.m. Annual meeting and prize distribution.

THE "ELECTRICAL REVIEW" SERVICE DEPARTMENT.

We have to remind readers that Service Department inquiries should be accompanied by a stamped addressed envelope.

The makers or suppliers of the following devices are asked for:—

Luxor lighting fittings.
Mercier type mining bells.

NOTES.

E.S.C.A. Concert.—The Greater London Division of the Electricity Supply Commercial Association held a successful Bohemian concert, at Anderton's Hotel, Fleet Street, on April 13th. Mr. D. C. Clark, chairman, presided, and a long and varied programme was presented to an appreciative audience.

Locomotive Developments.—At a meeting of the North-East Coast Institution of Engineers and Shipbuilders, at Newcastle-on-Tyne, on April 20th, Mr. T. Grime read a paper upon the possibilities of increased efficiency in railway locomotives. The lines upon which locomotive developments might be expected, he said, were the construction of condensing steam locomotives, the electrification of railways, and the development of the internal combustion engine. The whole question of railway electrification was one of finance. The cost of the locomotives alone amounted to two to three times the cost of modern steam locomotives of corresponding capacity. There were many expensive items, such as power and sub-stations, third rails or overhead gear, &c., to be paid for and maintained in working order. The scrapping of existing plant was also an enormous item. In actual maintenance the electric locomotive, due to the elimination of the boiler, was possibly cheaper than the steam locomotive, but to obtain a fair basis the maintenance cost of generating and transmission equipment must be added to the locomotive's maintenance cost. In short, it might be said that only when very heavy traffic was the rule could any fair return be expected from electrification. The great obstacle in the way of the adaptation of an internal combustion engine for locomotive purposes was its lack of flexibility. By careful attention to detail it seemed possible to get an engine sufficiently flexible as regarded speed, but this alone was not sufficient. There was, however, a direct driving arrangement that had decided possibilities. This was the combination of steam and internal combustion engines, and particularly the Still engine. A great deal of attention was now being given to the indirectly-driven type of engine with an electrical or other transmission medium. Two examples of this type would shortly be under test at the works of Messrs. R. & W. Hawthorn, Leslie and Co., Ltd. For obvious reasons it was not advisable to discuss as yet the various devices which gave the internal combustion engine the required economy and flexibility, but the schemes looked most attractive on paper, and very high hopes were entertained as to the ultimate success of the proposals which were to be put to the test.

Electric Lamps in Mines.—In a paper read before the Manchester Geological and Mining Society recently, Sir Henry Hall said the substitution of the electric safety lamp for the Davy lamp in British coal mines was proceeding at the rate of about 22,000 per annum. At the end of 1921 the numbers were 605,566 oil flame lamps (Davy) and 268,538 electric safety lamps, and probably by the end of last year the latter number had increased to 300,000. So momentous a change should not be made unless it was conclusively shown that it was wise and sound policy, and he was surprised that no serious protest had come from any quarter. The two types were widely different in character. The Davy lamp not only provided light for the miner; it also enabled him to make a simple and perfectly reliable test of the quality of the atmosphere in which he worked, and he was given timely warning of danger from firedamp or other noxious gas. The electric lamp was unaffected by any change outside itself. The evidence given at recent inquiries into explosions suggested that sinister effects of the change over to electric lamps were beginning to show themselves.

In the discussion the president (Sir T. Ratcliffe Ellis) pointed out that the greatest number of accidents in mines were caused by falls of roof and sides, and the better light given by the electric lamp gave the miner increased protection from that danger. Sir Henry Hall replied that the electric lamp had an advantage in the case of roof examination, but he would not allow it to be used by the men working at the face.

Mr. Miller said the better illumination from the electric lamp was undoubtedly an advantage. When it came into general use scientific men would be encouraged to invent a testing arrangement for use in combination with it.

Mr. H. O. Dixon thought the electric lamp was a step in advance, but every modern appliance met with opposition from people who preferred existing methods.

Sir Henry Hall said he would be satisfied if a working place was visited and examined every hour; if there was an interval of two or three hours between the visits the risk would be great. He would have been perfectly satisfied if the manufacturers of electric lamps had been told: "As soon as you can fit the lamps with something that will detect gas we shall not object to introducing them into the mine."

Lecture.—Lecturing before the Huddersfield Rotary Club on "Artificial Lighting," Mr. W. B. McLusky, the Halifax Corporation gas engineer, reviewed lighting from the days of the rush-light, through the candle and oil light stages to modern gas and electric lighting. Although he was engaged in the gas industry, he did not hesitate to pay tribute to the great development of electricity since its early use for lighting in 1880. In the busiest industrial West Yorkshire towns, he said, the electric motor was rapidly displacing the smoking chimney. In Halifax alone, 80 factory chimneys had ceased to pollute the atmosphere. The inestimable value of the change could not but be appreciated. Quite 90 per cent. of the total output of the largest electrical generating stations in industrial areas was used for power purposes. The business of artificial lighting would grow, but it would in time represent but a fraction of the total business done.

Electrically Sintered Magnesite.—Electrically sintered magnesite, a material having the highest melting point of any commercial refractory, is now being produced in quantity by the Carborundum Co. It is made from carefully selected California magnesite and is thoroughly fused in an electric furnace. It contains about 95 per cent. MgO and less than 1 per cent. of iron oxide, and has a melting point of about 2,600 deg. C.

The material is especially resistant at high temperatures to iron or iron oxide. This makes it most valuable for lining metallurgical furnaces, either in the form of bricks or in granular form, tamped in. A further unusual feature of electrically sintered magnesite is that it does not contract when subjected to conditions encountered in industrial installations. —*Chem. & Met. Engineering.*

The Electrical Trades Benevolent Institution.—On Monday last, the annual general meeting of the E.T.B.I. was held at the offices of the Institution of Electrical Engineers, Mr. Frank Gill (president, I.E.E.) presiding.

The report of the Committee of Management for the past year showed that the total income from contributions for the year was £1,423, making, with the receipts from dividends and other sources, a total income of £2,356. An amount of £1,780 had been carried to capital account, after the payment of grants and expenses. During the year the sum of £3,560 had been invested in the purchase of £3,650 5 per cent. War Stock. As, however, the purchase of £1,315 of this was not completed until January 4th, 1923, the balance-sheet showed a total of invested funds amounting to £18,799. It was essential that the invested funds should be greatly increased, because pensions could only be paid out of dividends and interest on investments. The number of applications for assistance had been larger than in any previous year, and every qualified applicant had received assistance. The Local Advisory Committees had greatly assisted the work of the Institution, and their actions had caused the Institution to become better known, not only amongst those requiring assistance, but also among those who were able to contribute. The Committee hoped that the heads of firms would assist the Institution by encouraging members of their staffs to become members of the Institution, and by appointing collectors. The annual festival was held on November 29th, 1922, and was presided over by Sir James Kemnal, whose appeal resulted in a collection of £842.

The Committee again drew attention to the advantages of membership, which were briefly summarised as follows:—

(*a*) Provision for Oneself.—There will be an ever-increasing number of persons in this walk of life who, through ill-health or other misfortune, unexpectedly find themselves in a destitute position. Seeing that there is now more than £20,000 invested, a member (or a member's widow or dependents) brought to such an unfortunate position is assured of the ability of the Institution to give adequate assistance.

(*b*) Help for Others.—By becoming a member you assist towards giving temporary financial assistance to many who either are not qualified for pensions or only require some financial assistance to tide over difficulties.

Membership carries with it voting powers, to be exercised when any application is made for a pension. The subscription of members is 10s. per annum, or such larger amount as each member is willing to give, and it may be paid in instalments.

Introducing the report, Mr. Gill pointed out that the number of cases assisted was three times as many as in the previous year, and the amount disbursed had increased in the same ratio. The total sum invested was now over £20,000, but they must build up a larger amount to meet the demands that would be made on their resources as the industry grew older. Mr. J. Y. Fletcher seconded the motion to adopt the report and accounts, and remarked that their members did not include enough of the rank and file; a large number of small subscribers would be welcome.

The report and accounts were adopted, and Messrs. W. B. Esson, J. Y. Fletcher, R. B. Mitchell, Sir Ernest Spencer, and Sir George Sutton, retiring by rotation, were re-elected members of the Committee of Management; Messrs. J. Snow Huddleston, E. A. Gatehouse, R. Robson, and A. G. Blake were also elected. Votes of thanks to honorary officials, the Institution of Electrical Engineers, and the technical Press were recorded, Mr. Gill referring especially to the burden that lay on the shoulders of the hon. secretary, Mr. F. B. O. Hawes; and the proceedings closed with a vote of thanks to Mr. Gill.

The A.O.E.C.—On Monday evening last, the annual general meeting of the Association of Officers and Staff Members of Electricity (Power and Supply) Companies of Great Britain was held at Caxton Hall, Westminster. Mr. A. E. Beale presided, in the unavoidable absence of the president, Sir A. B. W. Kennedy, who, he said, had kindly consented to continue in that office. He urged the members to increase the membership, and stated that the Committee was anxious that the Association should increase its activities; the annual meeting might become a reunion, and other meetings might be arranged.

The report of the Executive Committee stated that during the year the most important event affecting the interests of the members had been the passing into law of the Electricity (Supply) Act, 1922; Section 21 of this Act effected a much-needed amendment of Section 16 of the Act of 1919, and materially increased the safeguards afforded. The statement of accounts showed a credit balance of £678, which had been invested in trustee securities. The Executive Committee pointed out that in the event of the liquidation of the Association it was obviously not right that a member who had recently joined it should share equally in the distribution of funds with those whose membership was longer, and proposed an amendment to the constitution providing that members should share in proportion to the number of annual subscriptions they had paid.

The report and accounts were unanimously adopted, and the retiring members of Committee were re-elected. Mr. A. C. Tappenden, re-elected as hon. treasurer, stated that during the last three months a large number of former members had rejoined the Association. Mr. O. M. Andrews was re-elected hon. secretary, and Mr. R. Litt hon. assistant secretary. A resolution amending the constitution as indicated above was unanimously adopted, and the hon. treasurer stated that the Association now had over £1,000 invested in Conversion Loan. A discussion then took place regarding the holding of additional meetings. The hon. secretary remarked that the Association, which was not a trade union, consisted mainly of members of the staffs of the London companies; in the provinces many staff men had joined another body, and naturally did not see their way to subscribe to both. The chairman mentioned that the membership was now about 250. A vote of thanks to the chairman concluded the proceedings.

Electro-Farming—The Making of Silage.—Referring to the article under this title by Mr. R. Borlase Matthews in our issue of April 13th, 1923, Messrs. Oerlikon, Ltd., inform us that the Oerlikon Co. has the sole right for Switzerland to exploit the system referred to, and not Messrs. Brown, Boveri & Co.; the article describes the contentions of the inventor of the system, namely, Mr. Theodore Schweizer, generally correctly. The tests which the Oerlikon Co. has been carrying out, and is still pursuing, have not yet reached finality, and until then the Oerlikon Co. intends to limit the application of the system to Switzerland.

"Sparkless Sparks."—In an advance note to *Science*, from a report to the Carnegie Institution of Washington, D. C., Mr. Carl Barus gives an account of a novel phenomenon, observed when endeavouring to take away all the internal pressure from a soap bubble by charging it electrostatically.

The charged bubble usually takes an oblique oval figure, being drawn out along the incidental lines of force. This expansion, on very slowly increasing the potential, reaches a maximum, after which the bubble suddenly, in fact spasmodically, jerks back to its original position and shape, remaining intact. With the same bubble a succession of 10 to 40 spasms may be easily obtained, at the end of which the bubble bursts. An aluminium electroscope placed below the bubble indicates a marked increment of potential, even at the least spasm of the bubble, from the beginning up to the maximum. With each such case, therefore, there is partial discharge, an outrush of ions, or an intermittent current. A few of the lines of force break loose and slide off.

Mr. Barus says: "As I understand the phenomenon, it is near the tip B', that the surface tensions acting with a component inward are first balanced by the electric pressure $2\pi\sigma^2$ outward. The application of the latter is strictly on the outer surface. Hence the surface layer of molecules is successively slid toward the point and then stripped off, until after ten or more repetitions the remaining tissue is so thin that it breaks. This ionised molecular exfoliation, which takes place entirely without light effects even in the dark, may be referred to as in the caption."

Appointments Vacant.—Engineer to take charge of design for the Admiralty (£300, plus bonus); plumber, jointer and meter fixer, for the Conway Corporation electricity department; the National Association of Supervising Electricians has vacancies for supervisors and foremen. (See our advertisement columns to-day.)

The Broadcasting Controversy.—The names of members of the committee appointed by the Postmaster-General to inquire into the subject of broadcasting are given in our "Parliamentary Notes" to-day.

The British Broadcasting Co. has issued an official statement, pointing out that the difference between it and the P.M.G. arose from his declaration that unless the company agreed to his proposal, which struck at the fundamental principles of the agreement, he would issue 40,000 experimenters' licences indiscriminately. The company had always contended that any action of this kind would constitute an evasion of the agreement, and evidently the Attorney-General had so advised him. Nothing in the agreement was intended to protect any one British manufacturer against another; the whole object of the introduction of the B.B.C. mark was to make broadcasting possible, and to protect all British manufacturers equally against the dumping of foreign sets manufactured by cheap labour. The proposal of the P.M.G., if accepted by the B.B.C., would have killed the industry in this country and secured it for the foreigner. There could have been no broadcasting without the agreement; under it, broadcasting had made amazing progress.

The authorship of the agreement has been the subject of controversy in the lay Press; the facts are that it was negotiated between the Post Office, Mr. Kellaway being Postmaster-General, and the company which was in course of formation in the autumn of 1922. The agreement was completed during Mr. Kellaway's term of office, and on becoming Postmaster-General, Mr. Neville Chamberlain found it ready for execution; he signed it without alteration.

I.E.E. Subscriptions.—We have received from Mr. F. W. Purse, M.I.E.E., engineer and manager of the electricity department of the Borough of West Ham, copies of correspondence which has taken place between him and the Institution of Electrical Engineers with regard to the rates of subscription. Mr. Purse, on January 2nd, wrote to the secretary submitting that the subscription should be reduced, as many of the members were suffering severe reductions in their incomes. On March 15th the secretary informed him that the Council had considered the matter very carefully, and that it was not yet possible to reduce subscriptions; the cost of printing and paper, travelling expenses, and rates had greatly increased since 1914, and though these items were not now so high as they had been, some time must necessarily elapse before the Institution received the full benefit of the reductions that had taken place. Mr. Purse returned to the charge on March 19th, expressing disappointment with the conclusions which the Council had arrived at, declining to accept as valid the reasons given in the secretary's letter and contending that the subscriptions had been increased beyond what was necessary; if it was the decision of the Council to maintain the subscriptions for the present year at the existing rates with no definite relief at an early date the matter must be dealt with in another way. On April 19th the secretary replied, giving the Finance Committee's comments on Mr. Purse's observations, and informing him that while it was not practicable to make any reduction in respect of the current year, there were indications that the financial outlook of the Institution was improving, and the president hoped to be able to make a statement at the annual general meeting dealing with alternative methods of disposing of such surplus as might be anticipated in the future.

Hardness Tests Research.—Two papers in the above connection were read at the Institution of Mechanical Engineers on April 20th. In a paper on "Static Indentation Tests," by Mr. R. G. C. Batson, of the National Physical Laboratory, the following points were considered: (i) Investigation of the law of comparison for ball indentation tests; (ii) a comparison of the ball and cone methods of testing; and (iii) the determination of the relative hardness of very hard steels by means of ball hardness tests, in which the permanent deformation of the ball is taken as a measure of the material producing it. The other paper, by Mr. G. A. Hankins (also of the N.P.L.), dealt with "The Relation between Width of Scratch and Load on Diamond in the Scratch Hardness Test."

At the same meeting Mr. E. G. Herbert, of Manchester, demonstrated his pendulum hardness tester, which we described in our "New Devices" column last week. This is found to give results which agree very closely with those obtained by the Brinell method, and in the case of the hardest materials it is more satisfactory, as it does not rely upon the microscopic measurement of an indentation.

The Conjoint Board of Scientific Societies.—In a recently published report the Board reviews the work which it has done from its formation in 1916 to 1922. Among its numerous activities are mentioned its Watching Committee on Education, which has rendered valuable assistance in many directions; the investigation of certain anomalies revealed in the magnetic survey of Great Britain; and work in connection with the application of science to agriculture, including reports upon the design of an electrical tractor and other machinery. One of the most important pieces of work undertaken by the Board has been that of its Committee on the Water-Power Resources of the Empire, which has drawn up three elaborate reports. The work of Committees on the metric system and the international catalogue of scientific literature is also touched upon. The financial statement shows an expenditure of £3,306 and a balance in hand of £79.

Breakdowns Due to Dust.—In a report recently presented to the Sydney City Council the general manager of the electricity department (Mr. Mackay) stated that a number of failures in the supply of electricity occurred recently, the more remote western suburbs being seriously affected, and several of the northern suburbs were deprived of their supply for about half an hour. The cause of those interruptions, Mr. Mackay reported, was a particular trouble with which the electricity department had not yet found a way of effectively dealing. During a long period without rain, particularly if there are high winds, the insulators carrying the high-pressure wires of the overhead mains become coated more or less on all surfaces with dust. If the period of drought ends with a heavy fall of rain no harm results, as the heavy rain washes the dust off the insulators in a few seconds. But if the end of the drought comes in the shape of very fine, drizzling rain or mist, the dust on the insulators in the first place absorbs the moisture and makes a coating of what is in effect mud, which clings to the surface of the insulators, and acts as a conductor until it is finally washed away by the rain. Attempts are made by the electricity department to deal with this trouble by cleaning the high-pressure insulators from time to time during a period of drought, but so far it has proved impracticable to guard entirely against the trouble.—*Industrial Australian and Mining Standard.*

German Patents in France.—The newspapers state that the Commission examining the question of German patents taken out in France which, according the Treaty of Versailles, may be used in France, has recommended that the Meissner radio-electric patent be forthwith put to use.—*Reuter.*

INSTITUTION NOTES.

Diesel Engine Users' Association.—At the April meeting of the Association, members were invited to offer suggestions in connection with the proposal to alter the name of the Association so as to embrace types of heavy oil engines other than Diesel engines. Reference was made to the work of a Sub-committee of the British Engineering Standards Association on prime movers for electrical plant. It was understood that this Sub-committee was engaged in drafting a specification for heavy oil engines, and that the definition of a heavy oil engine was under consideration. It was decided to defer further consideration of the suggestion to change the name of the Association in the hope that a satisfactory definition of the types of engine known as the heavy oil engine might be available before long as a result of the labours of the Sub-committee referred to.

Institution of Welding Engineers.—Sir W. Peter Rylands, J.P., has been elected the first president of this Institution. The vice-presidents are Sir R. A. Hadfield, Bart., F.R.S., Prof. F. C. Thompson, B.Sc., D.Met., and Mr. Charles Bingham. Full particulars and membership application forms can be obtained from the temporary office, 30, Red Lion Square, W.C.1.

Association of Mining Electrical Engineers.—The West of Scotland Branch of the Association has elected Mr. David Martin chairman of the branch, and Messrs. David McQueen and D. Landale Frew vice-chairmen. Mr. D. S. Baddeley was appointed hon. secretary and Mr. C. E. Hart hon. treasurer.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

In our last issue we devoted the greater part of this column to a brief sketch of the career of Professor Magnus Maclean, who is retiring from the Chair of Electrical Engineering at the Royal Technical College, Glasgow. It is now our pleasing duty to congratulate Dr. Stanley Parker Smith upon his appointment as Prof. Maclean's successor.

Dr. Parker Smith, who is familiar to our readers, both on account of his contributions to the literature of motor and generator design, and his participation in Institution discussions, was born in 1884. His earlier education was received at Sedgebrook and Grantham, and in 1901 he entered Armstrong College, Newcastle-upon-Tyne, where he stayed until 1905, having taken the degree of B.Sc (Dunelm). During this period he served (on the "sandwich" system) for two years in the shops—chiefly with Messrs. Scott & Mountain. In 1905 he went to Germany, to the Elektrotechnisches Institute der Technischen Hochschule, Carlsruhe, where he stayed for two or three years, studying under Prof. E. Arnold.

Elliott & Fry] [*London.*

Prof. Stanley Parker Smith, recently appointed to the Chair of Electrical Engineering at Glasgow Technical College.

His first professional appointment was with Messrs. Siemens Brothers' Dynamo Works, Stafford, as assistant in the Technical Department. From there he went to the General Electric Co.'s Witton works, where he was head of the design office, and was responsible for the design of over 190 machines—d.c. and a.c. generators and induction motors—all of capacities above 100 kW or h.p. While he was with the G.E.C. (1909-12) he received the degree of D.Sc. from Durham University. Dr. Smith's teaching experience commenced in 1912, when he became lecturer, and, later, assistant professor, in the Electrical Department of the City and Guilds (Engineering) College, a position which he continued to hold up to the date of his present appointment. During the earlier part of the War he was in the Transformer Department of the British Westinghouse Co., Trafford Park, and later (1916-20) he acted as consulting engineer to Messrs. Vickers, Ltd., for the design of large turbo-alternators, induction motors, &c. In 1918 he worked on gyroscope motors at the Royal Aircraft Establishment, Farnborough. Dr. Parker Smith has had considerable university experience. He is a member of the Faculty of Engineering, Secretary of the Board of Studies in Electrical Engineering, and Chairman of the Board of Examiners in Electrical Engineering in the University of London, and, in addition, he is an external examiner in Electrical Technology in the University of Manchester. Practically every year since 1905 has seen an original contribution from the knowledge and pen of Dr. Parker Smith. These have appeared in the technical journals, the journals of the Institutions of Electrical and Civil Engineers, and in book form. His I.E.E. papers have twice gained for him the Kelvin Premium and once an Extra Premium. From the Institution of Civil Engineers he received, in 1911, the Telford Premium for a paper on the use of single-phase commutator motors for electric traction. His published books include three on the theory and design of a.c. machines, d.c. machines, and induction motors respectively, and he has also made translations from German and French publications.

While congratulating Dr. Parker Smith on his appointment, which will give ample scope to his talents, we feel that the Governors of the College have also merited our felicitations upon their wise choice.

The marriage took place on April 18th, of Mr. William Marsh, manager of the Brighton Tramways, and Miss Margaret Dann, only daughter of Mr. Arthur Dann, late of Brighton.

Mr. W. A. Caldecott, D.Sc., has been appointed a member of the South African Electricity Control Board, *vice* Mr. H. J. van der Bijl, Ph.D., who has been appointed chairman of the Electricity Supply Commission.

Shoreditch Borough Council Law and Establishment Committee has had under consideration the question of retirement or re-engagement of Mr. C. Newton Russell, the borough electrical engineer, who attains the age of 65 on June 23rd, 1923, and recommends that the period of employment of Mr. Russell as borough electrical engineer be extended for a period of twelve months from June 20th, 1923.

Science reports that Dr. Elihu Thomson was tendered a dinner in the Boston City Club on March 29th by more than 75 friends and associates in the General Electric Co., and from Harvard University and the Massachusetts Institute of Technology, on the occasion of his 70th birthday anniversary. He was presented with a silver loving cup, the presentation being made by Walter C. Fish, formerly manager of the Lynn works, who served as toastmaster. There were addresses by various well-known men, including Professor A. E. Kennelly, of Harvard University, and Professor Dugald C. Jackson, of the Massachusetts Institute of Technology.

It was recently announced that Mr. C. Milton, of Loughborough, had been appointed borough electrical engineer of Gillingham, Kent. We now learn that the Special Advisory Committee of the Gillingham Council held a special meeting recently and had three fresh candidates before them. As a result the appointment has been given to Mr. S. G. Martlew, of Harrow, chief electrical engineer with Kodak, Ltd., since 1919.

The Southampton Town Council has adopted the recommendation of the Tramways Committee that Mr. P. J. Baker, works superintendent, should be appointed acting manager and engineer of the tramways for a period of six months at a salary of £600 per annum.

Mr. R. W. Dalton, H.M. Senior Trade Commissioner in Canada, leaves England on May 4th to take up his duties at Montreal.

Mr. Leonard Webster Pratt, elder son of the late Councillor Thos. Pratt, and senior director of the firm of Christopher Pratt & Sons, Ltd., of Bradford, was married on April 19th, at Spofforth, to Miss Marie Alton, only daughter of Mr. and Mrs. J. T. Alton, of Braham Hall, Plompton.

In accordance with a recent decision of the York City Council, the Electricity and Tramways Committee has been divided into separate bodies. At meetings held last week Alderman C. W. Shipley, J.P., was elected chairman of the Electrical Committee, with Councillor J. E. Gibbs (the City Sheriff) as vice-chairman; and Councillor Gibbs was elected chairman of the Tramways Committee, with Councillor J. W. Dow as vice-chairman. Alderman Shipley was the chairman of the late combined committee.

Y. Yamaka, managing director of the Shinyetsu Hydro-Electric Power Co., of Tokio, Japan, recently visited the plant of the Westinghouse Electric & Manufacturing Co., at East Pittsburgh, Pa., accompanied by Hikoichi Tsutsumi, manager of Takata & Co., of New York, Japanese representatives of the Westinghouse Co.

Dr. Edward P. Hyde, who organised the Nela Research Laboratories in 1908, and who for the past few years has occupied the position of Director of Research of the National Lamp Works of the General Electric Co. (U.S.A.), is resigning as from the end of June. Dr. Hyde, who has been active in scientific and technical affairs for a number of years, has decided to take a prolonged rest abroad.

Mr. William Kirkham, A.M.I.E.E., is resigning his position as manager of the Manchester branch of Siemens Bros. and Co., Ltd., and Siemens & English Electric Lamp Co., Ltd., having accepted the post of branch manager in Manchester for G. D. Peters & Co., Ltd., and Walker Vehicles, Ltd., of Caxton House, Westminster, S.W.1.

Mr. P. E. Peronne, of London, is the first prize-winner in an All-Electric House competition that has been run by our contemporary, *The Electrician*. The second winner is Mr. W. M. Craufurd (also of London), and the third, Mr. E. Whytock (of Glasgow).

Obituary.—Sir A. J. Hobson.—We regret to record the death, at the age of 55 years, of Sir Albert John Hobson, one of the leaders of Sheffield industry, chairman and director of various companies connected with the steel industries, a president of the Sheffield Chamber of Commerce, Lord Mayor of the City, a chairman of the Corporation Finance Committee, and a vice-president of the Federation of British Industries. He was made a knight last year. The career of Sir Alfred was a most remarkable one. He was afflicted with serious physical disability (infantile paralysis) from his earliest childhood, but he rose superior altogether to his infirmity, lived a life full of great industrial and public achievement, and he leaves an inspiring example of courageous victory over a natural handicap, which should enhearten large numbers of other people who are tempted to depression and discouragement by less serious disabilities.

Mr. J. Haley.—James Haley, electrical engineer, of King Cross Street, Halifax, died suddenly on April 15th, at the age of 39.

Mr. J. A. Dick.—The death has occurred, at Cassis, Bouches-du-Rhone, France, of Mr. John Alexander Dick, who was until lately partner in the firm of Dick's Asbestos Co., of London, E.C. He was 46 years of age.

Dr. S. S. Wheeler.—We regret to learn that Dr. S. S. Wheeler, of the Crocker Wheeler Co., died suddenly of heart attack a few days ago. He was one of the American delegates to the recent Geneva meetings of the International Electrotechnical Commission and was a prominent member of the electrical engineering industry of America.

Mr. Henry Benest.—It is with feelings of deep regret that we have to record the death, at the age of 81 years, which occurred on April 17th at Ashgrove, The Glebe, Blackheath, S.E., of Captain Henry Benest, for many years with the India Rubber, Gutta Percha and Telegraph Works Co., Ltd., of Silvertown. In the service of that and other companies the deceased gentleman had travelled—on cable-laying expeditions—in all seas, and had acquired a sound and expert knowledge regarding deep-sea soundings. By ourselves and a host of others, he was highly esteemed as a personal friend. Captain Benest was first associated with submarine cable telegraphy when he was appointed to the engineering staff of the *Dacia* by the late Sir Charles Bright, for the laying of the West India Cables (1869-1871). In 1872 he was with the India Rubber Co. (Silvertown) for the laying of the Direct Spanish Cable (Lizard to Bilbao) the chief engineer then being Mr. F. C. Webb. In 1875 Mr. Benest was engaged in the laying of the West Coast of America cable between Lima, Peru, and Valparaiso, Chile, under Mr. Robert Kaye Gray. He was then given the command of the West Coast of America Co. for the repairing ship *Retriever*. On giving up this post he returned to the Silvertown Co. and took part in the laying of the Central South America cables on the West Coast of America, also the Canary Island cables, West Coast of Africa cables, and the Western Brazilian cables. Subsequently he was engineer-in-charge for several expeditions, including the laying of a French Atlantic cable, the Canso-New York cable, the Western Waterville cable, the San Francisco-Honolulu, the Manila-Shanghai, and the New York-Havana cables. Mr. Benest retired eight years ago. The funeral ceremony took place at Hither Green Cemetery on Monday last. Among those present were Mr. William Gray, and Captain Morton who was chief to Mr. Benest on the *Retriever*, and who first went out with him 47 years ago.

Will.—The late Sir John Gavey left £9,318 gross and £9,026 net personalty.

NEW COMPANIES REGISTERED.

Birmingham Wireless Co., Ltd. (189,305).—Private company. Registered April 18th. Capital, £1,500 in £1 shares. To take over the business of manufacturers and factors of and agents for wireless sets and apparatus carried on by E. D. Gledall and C. D. Aston at Carlton House, High Street, and 7 and 9, Pershore Street, Birmingham, as the Birmingham Radio Co. The first directors are:—E. D. Gledall, 42, Anderton Park Road, Moseley, Birmingham, telegraph engineer (managing director); C. D. Aston, 47, Lee Crescent, Edgbaston, Birmingham, wireless operator. Qualification, £100. Remuneration as fixed by the company. Secretary: C. D. Aston. Registered office: 7 and 9, Pershore Street, Birmingham.

Embleton & Barker, Ltd. (189,199).—Private company. Registered April 13th. Capital, £1,000 in £1 shares. To adopt an agreement with F. Embleton and G. W. Barker, and to carry on the business of electrical engineers, manufacturers of electrical machinery, apparatus, instruments, cable, glass and porcelain ware, insulation materials, &c. The first directors are:—F. Embleton, 28, Chandos Street, Gateshead; G. W. Barker (manager), 26, Egremont Drive, Gateshead; R. Allinson, 2, Bewick Road, Gateshead (all permanent, subject to holding 200 ordinary shares each). Registered office: 70, West Street, Gateshead-on-Tyne, Durham.

Bruce Campbell, Ltd. (189,184).—Private company. Registered April 12th. Capital, £1,500 in £1 shares (250 founders'). To acquire the business of electrical engineer and contractor carried on by F. B. Campbell, at Preston, as "Bruce Campbell," and to carry on the business of electrical and mechanical engineers, contractors, manufacturers of and dealers in electric, magnetic, telegraphic, telephonic, and other appliances, manufacturers of and dealers in wireless telegraphs and telephones, &c. The first directors are:—F. B. Campbell (managing director), 8, Tulketh Brow, Ashton-on-Ribble, Preston; H. H. Topping, 19, Grosvenor Place, Preston; S. Foster, 150, Tulketh Brow, Ashton-on-Ribble, Preston. Qualification, £1. Registered office: 8, Tulketh Brow, Ashton-on-Ribble, Preston.

Electricity Finance and Distribution Corporation (189,128).—Registered as a private company on April 16th, with a nominal capital of £2,000 in 1,800 non-cumulative 10 per cent. preference shares of £1 and 4,000 ordinary shares of 1s. each. The objects are: To acquire, develop, amalgamate or carry on any trade of electric lighting, or any business relating to the electrical distribution of light, heat and power, electrical and general engineering, building, contracting for the supply and construction of works incidental to electrical engineering, &c. Also to act as stock and sharebrokers and underwriters; to promote any Provisional Order or Act of Parliament for establishing electrical undertakings or light railways, &c. The subscribers (each with one preference share) are:—W. Burton, 43, Cannon Street, E.C.4, managing clerk; W. Thompson, 43, Cannon Street, E.C.4, solicitor. The subscribers are to appoint the first directors. Qualification, £25. Remuneration as fixed by the board. Secretary (*pro. tem.*): W. Burton. The registered office is at 43, Cannon Street, E.C.4.

Kent Bros. Electric Wire Co. and E. H. Phillips, Ltd. (189,314).—Private company. Registered April 18th. Capital, £15,000 in £1 shares. To acquire all or any of the assets of the business now carried on at Perry Hill, Catford, Kent, and 15, Berners Street, W., as "The Kent Bros. Electric Wire Co. and E. H. Phillips," and to carry on the business of manufacturers of, and dealers in electrical, mechanical, and scientific apparatus, appliances and accessories, telephones, telegraphs, wireless instruments and accessories, wire, cables and materials for making cables and cable equipment of all kinds, &c. The permanent directors are:—Arthur Kent (chairman), no address given; Albert Kent, 35, Eastcombe Avenue, Charlton, S.E.7, electrical engineer; E. H. Phillips, "Hurstmead," Eltham Square, S.E.9, electrical engineer. The two last-named are joint managing directors. Remuneration as fixed by the company. Solicitors: Harrington, Edwards and Cobban, 33, Southampton Street, Strand, W.C.2.

Wireless Accessories Stores, Ltd. (189,213).—Private company. Registered April 13th. Capital, £500 in £1 shares. To carry on the business of manufacturers of all kinds of electrical appliances and wireless accessories, warehousemen, shipping agents, commission agents, insurance brokers, bankers and general merchants, &c. The first directors are:—E. W. Adams, 108, Canterbury Road, Old Kent Road, S.E.15, retailer of wireless instruments; J. Bishop, 17, Canterbury Road, Old Kent Road, S.E.15, cabinet maker. Qualification: 1 share. Registered office: 664, Old Kent Road, S.E.

Scammell & Abbott, Ltd. (189,323).—Private company. Registered April 18th. Capital, £1,000 in £1 shares. To carry on the business of electrical engineers and wireless telegraphy and telephony engineers, &c. The first directors are:—E. W. Scammell, 147, Solihull Road, Sparkhill, Birmingham; S. H. Van Abbott, Warwick Road, Acocks Green, Birmingham (both permanent for 15 years, subject to holding £100 shares each). Remuneration of permanent directors, £350 each per annum. Solicitors: K. Povey-Harper, 136, Corporation Street, Birmingham.

Albert & J. M. Anderson Manufacturing Co. (2,205 F).—Particulars were filed on April 17th, 1923, pursuant to Section 274 of the Companies (Consolidation) Act. The capital is 600,000 dollars in 100-dollar shares. The company was incorporated in Massachusetts, U.S.A., on December 22nd, 1922, to manufacture and deal in electrical motors, dynamos, and other electrical machinery, &c. The British address is 12, Moor Lane, E.C., where S. C. Hackney is authorised to accept service of process and notices on behalf of the company. The directors are:—J. M. Anderson, Brooklin; A. E. Anderson, Milton; M. Anderson and A. B. Anderson, Boston; and A. Anderson, Newton Highlands, all in Massachusetts, U.S.A.

John Armstrong & Co. (Manchester), Ltd. (189,290).—Private company. Registered April 17th. Capital, £2,400 in £1 shares. To adopt an agreement with John Armstrong, and to carry on the business of electrical engineers and contractors, and dealers in all kinds of material, apparatus and appliances connected with the use of electricity, &c. The first directors are:—J. Armstrong, 2, Disley Avenue, Cavendish Road, West Didsbury, Manchester; Mrs. Alice Armstrong, 2, Disley Avenue, Cavendish Road, West Didsbury, Manchester. The said J. Armstrong is permanent governing director and chairman, subject to holding one quarter of the issued share capital. Qualification, 1 share. Remuneration as fixed by the company. Registered office: Lancaster Buildings, Barton Square, Manchester.

Horace Green & Co., Ltd. (189,253).—Private company. Registered April 16th. Capital, £20,000 in £1 shares. To take over the business of dynamo motor manufacturers and electrical engineers carried on by H. Green, G. S. Green, L. R. Green, A. Green, and Julia Green at Cononley, Yorks., as "Horace Green & Co." The first directors are:—H. Green, "Beech Mount," Cononley, near Skipton; G. S. Green, "Westfield," Bradley, via Keighley; L. R. Green, Cononley Hall, Cononley, near Skipton; A. Green, "Harewood," Skipton. Remuneration as fixed by the company. Registered office: Station Mills, Cononley, near Keighley.

S. S. Wireless Co., Ltd. (189,265).—Private company. Registered April 16th. Capital, £100 in £1 shares. To establish, work, manage, control, and regulate wireless and line telegraph and telephone exchanges and works for the supply of electric light, heat and motive power, and to transmit and facilitate the transmission of telegraphic and telephonic communications and messages, &c. The permanent directors are:—A. Salomon, Drinkwater Arcade, Coventry; A. Saffer, 10, Harehills Avenue, Leeds; M. H. Saffer, "Westbrook," Birch Grove, Manchester. Qualification, 1 share. Registered office: 95, Deansgate, Manchester.

Wireless Club, Ltd. (189,214).—Private company. Registered April 13th. Capital, £500 in 25 preference shares of £10 each and 250 ordinary shares of £1 each. To promote an association and provide club accommodation for wireless users, apparatus makers, dealers and licence holders; to acquire from H.M. Postmaster-General such licences as may be obtainable for broadcasting, &c. The first directors are:—W. Glass, "The Corner House," Hampton Wick; L. A. Gordon, 82, Longbridge Road, Barking; S. C. Samuel, 74, Fairview Road, Stamford Hill, N.; J. H. Worrall, 5, Harpur Street, W.C.1. Qualification, 100 ordinary or 5 preference shares. Secretary: J. H. Worrall. Solicitor: Albert Albu, 32, Shaftesbury Avenue, W.1.

"M. K" Electric, Ltd. (189,291).—Private company. Registered April 17th. Capital, £2,000 in £1 shares. To acquire the business of manufacturers of general electrical accessories and appliances, &c., carried on as the "Heavy Current Electric Accessories Co." at Park Road, Edmonton, Middlesex. The life directors are:—C. L. Arnold, 34, Abbey Road, Bush Hill Park, Enfield, electrical engineer; C. R. Belling, 10, Glebe Road, Enfield, electrical engineer. Qualification of life directors, £500; of ordinary directors, £5. Secretary: C. L. Arnold. Registered office: Barrett's Factory, Park Road, Edmonton, N.18.

Townlea Electrical Co., Ltd. (189,297).—Private company. Registered April 17th. Capital, £1,000 in £1 shares (300 6 per cent. preference and 700 ordinary). To acquire the business of electrical engineers now carried on by A. J. Horn and D. C. Tibbles at 112a, High Street, Willesden Junction, as the "Townlea Electrical Repair Co." The permanent directors are:—A. J. Horn, 14, Wendover Road, Harlesden, N.W.10; D. C. Tibbles, 27, Station Road, Kensal Rise, N.W.10. Qualification, £100. Remuneration of first directors, £25 each per annum; of other directors as fixed by the company. Registered office: 112a, High Street, Harlesden, N.W.10.

Fivemiletown Electric Supply, Ltd. (NI.56).—Private company. Registered in Belfast April 3rd. Capital, £1,900 in £1 shares. To carry on the business of electricians, engineers, &c. The first directors are:—W. J. Gillespie, Fivemiletown, merchant; J. Tavener, Fivemiletown, merchant; J. Cullinan, Fivemiletown, merchant; D. McCaffrey, Fivemiletown, victualler; R. S. Anderson, Fivemiletown, chemist; J. W. Johnston, Fivemiletown, merchant; S. Breadon, Fivemiletown, National school teacher; T. W. Carson, Fivemiletown, clerk of Petty Sessions; J. Martin, Fivemiletown, merchant. Secretary: S. Breadon. Registered office: Fivemiletown.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Practical Machines Co. (A. T. Gadsby), Ltd.—Particulars filed of £1,200 debentures authorised March 27th, 1923, charged on the company's undertaking and property, present and future, including uncalled capital, the whole amount being now issued.

Stockport Lamp Co., Ltd.—Particulars filed of £3,000 debentures authorised March 7th, 1923, charged on the company's undertaking and property, present and future, including uncalled capital, the whole amount being now issued.

Runbaken Magneto Co., Ltd.—Particulars filed of £5,000 debentures authorised March 26th, 1923, charged on the company's undertaking and property, present and future, including uncalled capital, the whole amount being now issued.

Concordia Electric Wire Co., Ltd.—Debenture dated March 31st, 1923, to secure £9,500 and further advances, constituting a specific charge on the real and leasehold property and goodwill and a floating charge on the other assets of the company subject as to such part of the said property, as is affected thereby to a certain debenture dated January 25th, 1923. Holder: E. J. Knight, Woodlands Cottage, Burton-on-Trent.

Cambridge Electric Supply Co., Ltd. (36,457).—Return dated March 14th, 1923. Capital, £160,000 in £10 shares. All shares taken up. £100,000 paid. Mortgages and charges at date of return, £57,450. Since the date of the return, £550 debentures (balance of a series of £13,000 already created) have been issued, and £17,000 new debentures have also been issued. (The new £17,000 and the old £13,000 now make one series of £30,000 "C" debentures.)

Costa Rica Electric Light & Traction Co., Ltd. (56,447).—Return dated March 21st, 1923. Capital, £130,000 in £1 shares. All shares taken up. £7 paid. £129,993 considered as paid. Mortgages and charges, £286,650.

Melbourne Electric Supply Co., Ltd. (63,334).—Return dated January 3rd, 1923. Capital, £1,750,000 in 150,000 8 per cent. first preference shares of £5 each and £1,000,000 consolidated ordinary stock. 100,000 preference shares and £800,600 consolidated ordinary stock taken up. £1,286,445 paid on 100,000 preference shares and £786,445 consolidated ordinary stock. £14,155 considered as paid on £14,155 consolidated ordinary stock. Mortgages and charges, £1,244,581.

Pirelli, Ltd. (103,068).—Return dated November 8th, 1922. Capital, £350,000 in £1 shares. 200,000 shares taken up. £200,000 paid. Mortgages and charges, nil.

Pryco, Ltd.—L. W. Stanley, of 9 and 10, Pancras Lane, E.C., was appointed receiver and manager on April 5th, 1923, under powers contained in debentures dated October 30th, 1922.

Kelvin-Hardy Electric Co., Ltd.—A. A. Whittingham-Jones, of 41, Castle Street, Liverpool, ceased to act as receiver and manager on April 9th, 1923.

East Anglian Electricity, Ltd.—Mortgage debenture dated April 4th, 1923, to secure £1,000, charged on the company's undertaking and property, present and future. Holder: L. H. Vulliamy, Ipswich.

James Keith & Blackman Co., Ltd.—Issue on April 10th, 1923, of £200 debentures, part of a series already registered.

Expert Electrical Co., Ltd.—Particulars filed of £1,350 debentures authorised April 13th, 1923, charged on the company's undertaking and property, present and future, including uncalled capital, the whole amount being now issued.

Palmer, Riley & Co., Ltd.—Further charge on certain land and premises in Accrington, dated March 27th, 1923, to secure £300. Holder: O. Clegg, 93, Dowry Street, Accrington.

Radio Appliances, Ltd.—Particulars filed of £1,000 debentures authorised April 9th, 1923, charged on the company's undertaking and property, present and future, including uncalled capital, the whole amount being now issued.

Edmundson's Electricity Corporation, Ltd.—Satisfaction in full on February 21st, 1923, of charge dated April 13th, 1920, securing £75,000 6½ per cent. three-year notes.

Radio Communication Co., Ltd.—Satisfaction in full on March 31st, 1923, of debentures dated October 24th, 1921, securing £23,000.

Telegraph Construction and Maintenance Co., Ltd. (1,147 C).—Return dated March 22nd, 1923. Capital, £896,400 in £12 shares. All shares taken up. £448,200 paid; £448,200 considered as paid. Mortgages and charges, nil.

W. T. Glover & Co., Ltd. (56,124).—Return dated April 5th, 1923. Capital, £214,850 in 100,000 preference and 114,850 ordinary shares of £1 each. All shares taken up. £117,000 paid on 67,000 preference and 50,000 ordinary; £97,850 considered as paid on 33,000 preference and 64,850 ordinary shares. Mortgages and charges, nil.

Charing Cross, West End and City Electricity Supply Co., Ltd. (29,122).—Return dated March 22nd, 1923. Capital, £2,100,000 in 130,000 preference, 130,000 ordinary, 80,000 City undertaking preference, and 80,000 City undertaking ordinary shares of £5 each. 80,000 preference, 80,000 ordinary, 80,000 City undertaking preference, and 70,000 City undertaking ordinary shares taken up; £1,200,000 paid on the preference, ordinary, and City undertaking preference shares; £350,000 considered as paid on the City undertaking ordinary. Mortgages and charges, £1,336,178.

Northallerton Electric Light and Power Co., Ltd. (59,301).—Return dated March 14th, 1923. Capital, £6,500 in 2,900 preference shares of £1 each and 12,000 ordinary shares of 6s. each. 1,161 preference and 7,829 ordinary shares taken up; £3,509 14s. paid. Mortgages and charges, £3,900.

City of London Electric Lighting Co., Ltd. (34,406).—Return dated April 4th, 1923. Capital, £2,000,000 in 400,000 6 per cent. first preference, 300,000 8 per cent. second preference, and 800,000 ordinary shares of £1 each, and £500,000 undenominated. 400,000 first preference, 300,000 second preference, and 600,000 ordinary shares taken up; £1,500,000 paid. Mortgages and charges, £900,000.

A. L. Brown & Co., Ltd.—H. F. Mitchell, of 12, Foubert's Place, Regent Street, W., ceased to act as receiver or manager on March 31st, 1923.

Universal Welding Co., Ltd.—Satisfaction in full on March 27th, 1923, of debenture dated June 14th, 1920, securing £1,250.

Electric Construction Co., Ltd.—Satisfaction to the extent of a further £9,130 on March 27th, 1923, of first mortgage debenture stock secured by trust deed dated December 16th, 1897, securing £200,000.

Lancashire United Tramways, Ltd. (87,044).—Return dated March 14th, 1923. Capital, £200,000 in £1 shares. 192,878 shares taken up. £7 paid; £192,871 considered as paid. Mortgages and charges, £548,500 (£250,000 prior lien debenture stock and £298,500 second mortgage debenture stock).* Deferred debenture stock issued, having no charge over the assets of the company, £83,330.

*A further £40,000 of this stock has been deposited as security for possible advances.

Hindhead and District Electric Light Co., Ltd.—Issue on March 27th, 1923, of £100 debentures, part of a series already registered.

Oxford Electric Co., Ltd. (34,685).—Return dated March 16th, 1923. Capital, £175,000 in £5 shares (20,000 ordinary and 15,000 preference). 20,000 ordinary and 11,000 preference shares taken up. £122,550 paid, including £1,550 paid on 310 shares forfeited. £34,000 considered as paid on 6,800 shares. Mortgages and charges, £75,000.

National Conduit and Cable Co., Ltd. (59,251).—Return dated December 31st, 1922. Capital, £1,000 in £1 shares. All shares taken up; £7 paid; £993 considered as paid. Mortgages and charges, nil.

Mather & Platt, Ltd. (60,387).—Return dated March 13th, 1923. Capital, £2,500,000 in 40,000 preference shares of £10 each and 2,100,000 ordinary shares of £1 each. 40,000 preference and 1,363,660 ordinary shares taken up. £10 per share called up on 39,200 preference and £1 per share on 338,660 ordinary. £630,660 paid; £1,133,000 considered as paid on 10,800 preference and 1,025,000 ordinary. Mortgages and charges, nil.

Dynamic Electrical Co., Ltd. (104,436).—Return dated December 31st, 1922. Capital, £100,000 in £1 shares. Seven shares taken up. £7 paid. Mortgages and charges, nil.

Newcastle and District Electric Lighting Co., Ltd. (28,022).—Return dated March 30th, 1923. Capital, £300,000 in £10 shares. All shares taken up. £297,500 paid; £2,500 remains in arrears. Mortgages and charges, £322,860.

CITY NOTES.

West London and Provincial Electric Supply Co., Ltd.

At the annual meeting, on April 18th, the chairman (Mr. Harry Kahn) said that the Chiswick Electric Supply Corporation, Ltd., from which the company derived the whole of its revenue, was paying a dividend of 10 per cent. as against 8 per cent. last year, increasing the balance of profit and loss of the company from £5,209 to £6,676. Of this amount the actual profit was £6,320, which the directors proposed to allocate as follows:—A dividend of 6 per cent. for the year on the cumulative preference shares; 4½ per cent. on the funding certificates; and 6 per cent. on the ordinary shares. The balance of about £1,800 would be applied to the redemption of funding certificates. The chairman then reviewed the results of working of the Chiswick Electric Supply Corporation (*vide* Elec Rev., April 13th), and the report and accounts were adopted.

British L. M. Ericsson Manufacturing Co., Ltd.

The report for 1922, which was presented at the annual meeting held on Monday, stated that the result shown reflected the severe depression through which traders generally and telephone manufacturers particularly had been passing during the last 18 months. The present outlook is brighter and hopes are entertained that the figures for 1923 will show a decided improvement. After writing down stocks to present-day values, and making allowance for depreciation of buildings, plant, &c., income tax, and interest on debentures, the net profit amounts to £10,681, to which is added £47,232, the amount brought forward (after adjustment of Corporation Profits Tax for 1921) so that the available balance is £57,913. After payment of the preference dividend £5,999, 8 per cent. (free of income tax), is to be paid on the ordinary shares £8,001, leaving £43,913 to be carried forward, subject to payment of Corporation Profits Tax for 1922. The sum of £15,000 set aside at the last annual meeting for contingencies has been used partly as extra depreciation of tools and the remainder for additional depreciation of stocks.

Resolutions were submitted to the meeting regarding the directors' remuneration, and the rate of interest on the first mortgage bonds created in 1912.

Calcutta Electric Supply Corporation, Ltd.

The directors' report for 1922, which is to be submitted at the annual meeting on April 30th, records an increase in the energy sold from 43,078,983 kWh to 51,598,579 kWh; the number of houses connected increased by 404 to 12,882. The gross revenue was £519,201, as against £432,179, and the net revenue rose from £216,977 to £285,681. The last amount, with a balance of £43,230 brought forward, gives an available total of £328,911 which it is proposed to allocate as follows:—Depreciation and renewals fund, £68,149; debenture interest, £41,039; preference dividend, £41,040; interim dividend on ordinary shares, £27,800; interest on consumers' deposits, £2,094; bank interest, £3,287; debenture sinking fund, £18,054; and reserve for taxation, £7,523. The balance of £119,924 is dealt with as follows:—Writing off of cost of debenture and share issues, £15,642; transferred to reserve, and depreciation and renewals funds, £12,267; insurance fund, £2,000; final dividend of 6 per cent. (actual) on the ordinary shares, making 10 per cent. for the year, plus a bonus of 1 per cent., £34,439; leaving £34,438 to be carried forward. It is proposed to grant the staff in India a bonus equivalent to 2 per cent. of the net Indian profit.

During the year an issue was made of 125,000 ordinary £1 shares at a premium of 2s. each, and 125,000 preference £1 shares at par. Under the Trade Facilities Act a guarantee was obtained for a loan of £500,000 on the security of a second mortgage debenture. Of this sum £200,000 was paid during the year.

English Electric Co., Ltd.

The report for the year ended December, 1922, which was submitted at the annual meeting on Wednesday, states that the balance to the credit of profit and loss account (including £55,599 brought forward and amounts transfered from reserves previously set aside and no longer required) was £318,265. Out of this debenture interest required £50,902; interest on 8 per cent. secured notes, £100,000; trustees' fees, £360; dividend of 6 per cent. on the preference shares, £41,914. A dividend on the ordinary shares at the rate of 5 per cent. per annum, less tax, will absorb £56,106; leaving to carry forward £68,983. "Although the orders received during 1922 showed a marked improvement on the previous year, the general depression in trade . . . continued during the greater part of the year. The position was further aggravated by the engineers' dispute, which lasted for fully three months, and gravely hampered all engineering concerns in this country." During 1922 the directors have pursued an active policy abroad, taking special measures for the representation of the company in countries offering business which it was in a position profitably to undertake. The results of these developments, combined with the closest attention to economy at headquarters and in the works, have made it possible to show a return which otherwise could not have been secured. "In addition to the extension of the business geographically, the technical development of the company's products has been continued and expanded. This activity has directly resulted in several important contracts being secured, particularly in railway electrification and water-power development schemes." The directors have persevered in their policy of reducing the stocks of material on hand to the lowest workable margin. This accounts to a considerable extent for the figure in the balance sheet which gives the value of the stocks and work-in-progress, and, it will be observed, is less by approximately £366,000 than the corresponding figure for the previous year.

Italian Companies.

The accounts for the past working year of the *Società Elettrica Negri*, of Genoa, whose capital is 110,000,000 lire, showed a considerable debit balance. The principal reasons for the loss are the difference on exchanges, and the depreciation of securities and credits.

The *Società Italiana dei Forni Elettrici e dell'Elettrocarbonium*, of Rome, has decided to reduce its capital from 7,000,000 to 3,000,000 lire, and eventually to raise it to the former figure again.

Madras Electric Tramways (1904), Ltd.

For 1922 there was a gross profit of £31,606. After debiting interest and London office expenses, providing for debenture stock sinking fund, and putting £10,000 to depreciation and renewal account, the balance is £11,110, plus £6,436 brought forward. The preference dividend, less tax, absorbs £6,000; 7 per cent., free of income tax, is to be paid on the ordinary shares; and £7,538 is carried forward. The traffic receipts and running expenses in rupees showed increases of 14.4 per cent. and 5.4 per cent. respectively on 1921. Motor-'bus competition continues, causing considerable additional wear and tear to the roads which the company has to maintain in accordance with its concession. The extension of the tramway in Mount Road and Bodyguard Road was opened on December 20th, giving an accelerated service and increased traffic; other steps are being taken to overcome the 'bus competition.

British Electric Transformer Co., Ltd.

The accounts for 1922 shows that after paying all manufacturing costs and expenses of administration there remains a net profit of £20,429, plus £12,708 brought forward, making £33,137. It is proposed to place to depreciation reserve £4,000. The preference dividend of 7 per cent. for the year requires £21,000, and £8,137 is to be carried forward. For the previous year the dividend was 10 per cent. plus a bonus of 2½ per cent. Meeting: May 1st, London.

German Companies.

The *Emag* (*Electricity Co.*) of Frankfort-on-Maine, intends to pay a dividend at the rate of 150 per cent. for 1922, this comparing with 22 per cent. in the previous year.

The *Felten & Guilleaume* (*Carlswerk*) *Co.*, of Cologne-Mulheim, proposes to pay a dividend at the rate of 80 gold pfennigs (about 10d.) per share of 1,000 marks nominal for 1922, this being equivalent to 4,000 paper marks.

The *Electricity Supply Co.*, of Berlin, records gross profits from the operation of supply works amounting to 50,940,000 marks for 1922, comparing with 13,540,000 marks in the previous year. Out of the net profits of 17,480,000 marks (5,180,000 marks in 1921) the directors recommend a dividend at the rate of 30 per cent., as contrasted with 16 per cent. in 1921.

The *Bergmann Electricity Works Co.*, of Berlin, reports gross profits for 1922, including 1,573,000 marks brought forward, amounting to 437,694,000 marks, as compared with 69,407,000 marks in 1921. After defraying general expenses, interest on loans, and depreciation, the net profits are returned at 341,847,000 marks, as against 19,573,000 marks in the previous year. It is proposed to pay a dividend at the rate of 200 per cent., this contrasting with 20 per cent. in 1921.

Babcock and Wilcox, Ltd.

Net profit during 1922, £787,601, plus £71,243 brought forward. After meeting the preference dividend, and total dividends of 17 per cent., free of tax, and a bonus of 3 per cent. on the ordinary shares, £200,000 is being put to reserve, £20,000 to staff pension fund, and £194,126 carried forward. The result of the trading of the Indian, Australian, Chinese and Japanese Branches was only included up to August 31st, 1921, being for eight months. The present balance sheet includes the returns from these branches up to September 30th, 1922 (thirteen months). These branches, and the company's other business abroad, have contributed to the considerable augmentation of the profit, which has also been favourably affected by the cessation of the E.P.D. and the reduced Income Tax. The new works in Australia have been completed and are actively in operation. The works in Japan have also been extended. The capacity of the works at Renfrew, Dumbarton and Oldbury, has been increased, in readiness to cope with the increase in business that is hoped for, and to reduce the cost of production. In view of the growth of the business, the ordinary share capital is to be doubled, and having regard to the expediency of conserving the resources of the company an amount equal to the paid up ordinary capital is to be taken from the reserve fund (as now proposed to be increased) and the share premium account, and applied in paying up in full a corresponding number of unissued ordinary shares, and these shares so paid up are to be issued to the ordinary shareholders at the rate of one new fully paid ordinary share for each ordinary share already held.

British Thomson-Houston Co., Ltd.—As abstracted in the financial Press, the report for the year 1922 shows a profit of £494,592, compared with £509,259 for 1921. Deducting interest on debentures and loans, £118,614, the net profit totals £375,978, against £389,813 for 1921. Including £230,704 brought forward the amount now available is £606,682, from which the directors recommend placing to reserve £50,000, and to depreciation of plant account £82,959. It is proposed to maintain the ordinary dividend at 6 per cent., tax free, carrying forward £236,671.

Companies to be Struck off the Register.—The following companies will be struck off the Register at the expiration of three months unless cause is shown to the contrary:—

F. Husband, Ltd.
Rotherham Electrical Engineering Co., Ltd.
Steel's Electric and Engineering Co., Ltd.
Tungsten and Rare Metals Co., Ltd.

Birmingham District Power and Traction Co.—Net revenue for 1922 from tramways and from dividends and interest on investments £88,788. After deducting administration and general expenses, payments to local authorities, income tax, insurance, debenture interest and sinking fund charges, providing for renewals, and paying the preference dividend, it is proposed to pay a dividend on the ordinary shares at the rate of 5 per cent. for the year and £3,959 is to be carried forward.

Montreal Companies.—Montreal Light, Heat and Power Consolidated Co., dividend at the rate of 6 per cent. per annum, for the quarter ending April 30th. Montreal Light, Heat & Power Co., a dividend at the rate of 8 per cent. per annum, for the same period.

Ever-Ready Co. (Great Britain), Ltd.—Final dividend of 6½ per cent. on both the preference and ordinary shares, making 10 per cent. for the year.

The Oerlikon Accumulator Works.—The accounts of the Accumulator Works Co., of Oerlikon, after having made provision for depreciation, show net profits of 601,000 fr. for 1922, as compared with 615,000 fr. in the previous year. As in 1921, the dividend is at the rate of 20 per cent. on share capital of 2,200,000 fr.

City Electric Light Co., Ltd. (Brisbane).—Credit balance for year ended January, 1923, £90,877; interim dividend paid, £41,258; further dividend of 3 per cent. on the 6 per cent. preference; 3½ per cent. on the 7 per cent. preference; and 5 per cent. on the ordinary shares, free of State Tax, are paid, absorbing £49,639. Carried forward £89.

Prospectus.—*North Metropolitan Electric Power Supply Co., Ltd.*—The prospectus was advertised on Monday last offering for subscription an issue of £350,000 5½ per cent. debenture stock at par. The list was to close on or before to-day, Friday.

Stock Exchange Notices.—The undermentioned have been ordered to be officially quoted:—

Melbourne Electric Supply Company.—£300,000 6 per cent. redeemable general mortgage debenture stock.

River Plate Electricity Co., Ltd.—Net revenue for 1922, £60,066. It is proposed to pay a dividend on the ordinary stock of 7 per cent., the same as for 1921, to place to general reserve £18,000, and to carry forward £9,680.

Peterborough Electric Traction Co., Ltd.—Net revenue for 1922, £23,015, a decrease of £6,251. Expenses decreased by £3,841. Dividend on preference shares 6 per cent., carrying forward £202.

Kaministiquia Power Co.—Quarterly dividend of 2 per cent.

STOCKS AND SHARES.

Tuesday Evening.

Gilt-edged and investment stocks show no diminution of strength in their prices. The markets for these are well maintained. In spite of a little rush of new prospectuses during the past few days, the offers of stocks and shares made by the newcomers have had no effect upon prices of existing securities, so eager is the public demand, so considerable the amount of capital available for such investments. The after-effect of the Budget continues to be favourable so far as it concerns the better-class issues, and it has had the effect of stimulating the boomlet in most industrial departments, the shares in which are in really active demand and with a constantly widening basis of public interest directed to them.

The principal rise in the market for home electricity shares is one of 10s. in Urban preference, which has lifted the price to 4¾. This is due, of course, to the expectation that the dividend will be augmented this year. Westminster ordinary at 9¾ are 7s. 6d. higher; Londons rose to 4¼, County of London to 2 and Charing Cross to 10½. It is interesting to notice that County of London ordinary shares now stand at relatively the highest price of any in the list, the return on the money, at the recently-declared 10 per cent. rate of dividend, being exactly 5 per cent. or less than the yield available from the same company's preference shares. The strength of the ordinary is a striking tribute to the confidence of the shareholders in the progressive character of the undertaking. City Lights are down a trifle to 2 5/16, a few shares having come in during the past few days. Chelseas at 8¼ are again ¼ up. Bournemouth & Poole second preference rose to 10.

The manufacturing group is firm. General Electric preference and English Electric preference are both 6d. higher. Electric Constructions retain their improvement at 28s. 9d. The company's dividend will be declared within the course of the next few weeks; last week's reference to it in this column as having been announced was due to a regrettable confusion. One of the manufacturing companies has in contemplation the issue of a substantial amount of new capital, details of which may be expected to reach the public within the first week or so of May.

Babcock & Wilcox shares have been extremely lively. The dividend of 9 per cent. made 17 per cent. for the year, with an additional 3 per cent., free of tax, bonus. Upon the announcement, the shares gave way from 4¼, but astute buyers picked up all the stock that was offered, and, within a very short space of time the price was up to 4½, so showing a gain of no less than 7s. 6d. on the week. The reaction which took place on the declaration of the dividend was due to disappointment at there being no announcement of a share bonus, but the report shows that the capital is to be doubled, and one new share will be given for every one at present held. Shares in all iron, coal, steel and engineering companies are in demand, and this department, like a good many others in the industrial market, is benefiting from the considerations that, with the Income and Corporation taxes lowered, all commercial undertakings of good character will go ahead.

Callenders, British Insulated, Henleys, and British Aluminium are all better on the week. The British Thomson-Houston Co. announces the same dividend, 6 per cent., free of tax, as that of a year ago. The year's profit comes out at £494,000, or £14,700 less, but the figures all round are good, and the company carries forward £237,000.

Shares in other companies which should be doing well out of the broadcasting business are not much affected this week. Marconis have recovered half their last week's loss, hardening to 2½, but while the broadcasting business remains in the muddle which obtains at present, people are not greatly attracted to these wireless shares. Most of the Eastern cable stocks and shares are better, rises having occurred in Eastern Extensions, Westerns, Globes of both classes, and Eastern Telegraph ordinary. Great Northerns continue their advance, and are now up to £30. Cuba Submarines hold their 10s. rise.

Anglo-Argentine Tramways first preference, rallying further from their recent flatness, are ¼ higher at 3½, and the 5 per cent. debenture stock recovered to 81. The latter may be regarded as one of the good second-class debentures in the industrial list. British Columbia stocks are better, and Mexicans firmed up, Mexican Light & Power first bonds putting on 3 points at 69½. Home Railway stocks are somewhat unsteady, Districts and Metropolitans both having fallen ¼, and the market as a whole being in less favour than it was a month ago, before the labour troubles started muttering.

The rubber share market is dull, owing to a further reaction in the price of the raw produce, but notwithstanding this, the subscription lists of one of the new issues closed on Monday morning within a couple of hours of its having been opened. London & Suburban ordinary at 1s. 9d. are a little lower on the week. Numbers of America-Canadian & Power issues have gained two or three points without attracting new business.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Nom.	Dividend. 1921.	Dividend. 1922.	Price April 24. 1923.	Rise or fall.	Yield p.c.
	£					
Brompton Ordinary	1	12	12	36/6	—	£6 11 4
Charing Cross Ordinary ...	5	9	14	10½	+½	6 13 4
do. do. do. 4½ Pref.	5	4½	4½	4½	—	5 6 0
Chelsea	5	6	10	8¼	—	6 1 3
City of London	1	14	15	2 5/16	− ¼	6 9 10
do. do. 6 % Pref. ...	1	6	6	23/-	—	5 4 4
County of London	1	8	10	2	+ 1/16	5 0 0
do. do. 6 % Pref. ...	1	6	6	1½	—	5 4 4
Edmundson's Ordinary	3	Nil	—	2¾	+ ⅛	Nil
do. 6 % Pref. ...	5	12/-	—	4⅜	—	6 13 4
Kensington Ordinary	5	10	12	8½	—	6 13 4
London Electric	3	4	10	4¾	+ ¼	6 3 1
do. do. 6 % Pref. ...	5	6	6	5⅛	—	5 17 1
Metropolitan	1	7	8½	28/6	—	5 19 4
do. 4½ % Pref.	1	4½	4½	17/-	—	5 6 0
Newcastle-on-Tyne Ordinary ...	1	Nil	2½	7/8	—	2 17 2
do. 5 % Pref. ...	1	5	5	15/9	+9d.	6 7 0
do. 7 % Pref. ...	1	7	7	23/6	—	5 19 2
Notting Hill, 6 per cent. Pref....	10	6	6	9½	—	6 9 9
North Met. Elec., 6 % Pref. ...	1	6	6	1 1/16xd	+6d.	5 13 0
Urban Ordinary	3	Nil	—	1⅜	—	Nil
do. 5 % Pref. ...	5	2½	—	4½	+ ⅛	5 5 3
St. James' and Pall Mall ...	5	12	14½	10⅞	—	6 15 0
South London	4	7	10	6⅞	—	5 16 3
South Metropolitan Pref. ...	1	7	7	1 5/16	—	5 14 10
Westminster Ordinary	5	10	12	9⅜	+ ⅜	6 8 0
Whitehall Elec. Invst., 7½ % Pf.	1	7½	7½	19/6	—	7 13 10

Home Rails.

Central London Ord. Assented	Stock	4	4	72	—	5 11 1
Metropolitan	,,	2½	3½	68½	−1	5 2 2
do. District	,,	1	3	55	− ½	5 9 2
Underground Electric Ordinary	10	Nil	Nil	3½	—	Nil
do. do. "A" ...	1	Nil	Nil	9/6	—	Nil
do. do. Income	Stock	4	5	96½	—	*5 3 9

Telegraphs and Telephones.

		Dividend. 1920.	Dividend. 1921.			
Anglo-Am. Tel. Pref.	Stock	6	6	103½xd	—	5 16 0
do. Def.	,,	1½	34/6	22½	— ½	6 13 4
Chile Telephone	5	6	6	6¼	—	4 16 0
Cuba Sub. Ord.	10	7	7	8	—	8 15 0
Eastern Extension	10	10	10	18½	+ ½	5 8 1
Eastern Tel. Ord....	Stock	10	10	186½	+ 1	5 7 3
Globe Tel. and T. Ord.	10	10	10	18⅝	+ ⅜	5 6 0
do. do. Pref.... ...	10	6	6	11½	+ ½	5 4 4
Great Northern Tel.	10	24	24	80	+ ½	7 6 8
Indo-European	25	10	10	37½	—	6 13 4
Marconi	1	25	15	2½	+ 1/16	5 0 0
Oriental Telephone Ord. ...	1	12	12	21¾	—	*4 5 5
United R. Plate Tel.	5	8	8	7½	—	*5 6 8
West India and Panama ...	10	Nil	Nil	5/-	—	Nil
Western Telegraph	10	10	10	18⅝	+ ¼	*5 7 5

Home and Foreign Trams, &c.

Anglo-Arg. Trams. First Pref.	5	5½	12½	3½	+ ¼	7 17 2
do. do. 2nd Pref.	5	Nil	5½	3	—	9 3 4
do. do. 5 % Deb.	Stock	5	5	81	+1	6 3 5
British Electric Traction Ord.	,,	4½	—	74½	—	6 0 10
do. do. 6 % Pref.	,,	6	6	99	—	6 1 3
Brazil Tractions...	100	Nil	Nil	54	—	7 8 2
Brit. Columbia Elec. Rly. Pce.	Stock	5	5	86½	+2	5 15 7
do. do. Preferred	,,	5	93/-	77½	—	*6 1 3
do. do. Deferred	,,	3	124/-	88½	—	*6 19 9
do. do. Deb. ...	,,	4½	4½	80	+2	5 6 3
Lond. & Sub. Trac. 5 % Pref.	1	2½	3½	11/-	—	9 2 0
London United Tramp. Deb. ...	Stock	4	4	64½	— ½	6 4 0
Mexico Tram. 5 % Bonds ...	—	Nil	Nil	81½	—	6 2 8
do. 6 % Bonds ...	—	Nil	Nil	61½	—	Nil
Mexican Light Common ...	100	Nil	Nil	22½	—	Nil
do. Pref.	100	Nil	Nil	69½	—	Nil
do. 1st Bonds ...	—	Nil	5	69½	+3	7 4 0

Manufacturing Companies.

Babcock & Wilcox	1	15	20	4½	+ ⅜	4 9 0
British Aluminium Ord. ...	1	10	5	21/9	+1/9	4 12 0
British Insulated Ord.	1	15	15	2 7/16	+ 1/16	6 3 0
Callenders...	1	15	15	2 1/16	+ 1/16	6 9 10
do. 6½ Pref.	1	6½	6½	1⅛	—	5 15 7
Crompton Ord.	1	10	5	⅞	—	6 13 4
Edison-Swan	1	10	Nil	4/3	—	Nil
do. do. 5 % Deb.	Stock	5	5	61	—	8 1 4
Electric Construction	1	10	10	28/9	—	6 19 2
English Electric	1	8	5	17/9	—	5 12 8
do. do. Pref.	1	6	6	19/6	+6d.	6 3 1
Gen. Elec. Pref.	1	6½	6½	23/3	+6d.	5 11 10
do. Ord.	1	10	5	21/9	—	4 12 0
Henley	1	15	15	2 1/16	+ ⅛	6 3 0
do. 4½ Pref.	5	4½	4½	8⅜	—	5 2 10
India-Rubber	1	10	—	⅜	—	—
Met.-Vickers Pref.	2	8	8	2½	—	6 8 0
Siemens Ord.	1	10	10	21/3	—	Nil
Telegraph Con.	12	20	20	25½	—	*4 16 0

* Dividends paid free of Income Tax.

COMPULSORY ARBITRATION IN TRADE DISPUTES.

(BY A LEGAL CONTRIBUTOR.)

Strikes and threats of strikes naturally lead many people to ask an old question—Is it not possible to establish a Court to which all industrial disputes shall be referred, a Court whose decrees shall be binding upon employers and workmen alike?

Great strikes are expensive not only to those immediately concerned, but to the country as a whole. It is certain that if it were possible to set up such a tribunal, its inauguration would be hailed with satisfaction by the community. Compared to the cost of an ordinary strike, the expense of such a Court would be negligible.

To some people it is matter for surprise that the Government has hitherto refrained from placing any measure upon the Statute-Book which would have the effect of establishing a strike tribunal. The nearest approach to anything of the kind is to be found in the Industrial Courts Act, 1919, by which trade disputes may be submitted to a Court by the Minister of Labour, *if both parties consent*. The element of compulsion is wanting. The reason why the Government has refrained from *compelling* arbitration is this—that hitherto no method has been devised for enabling an Industrial Court to enforce its decrees. It may be easy to declare that no employer shall pay less than a certain wage for a certain piece of work, or to tell a workman that he is not entitled to demand more than so much per week. But how are such declarations and orders to be enforced? Is it within the power of any Government, however well it may represent the will of the people, to insist that an employer shall keep a particular man in his employment? Can any executive body appointed by the Crown compel a man to work if he choose to remain idle? These are some of the difficulties of those who seek to draft a Compulsory Arbitration Act.

It may be said, of course, that compulsory arbitration has not been tried in this country. This is true enough; but it has been tried and with very little success in our own Dominions. In this connection it is useful to refer to what took place some years ago in Australia. In 1903 the miners in the collieries of the northern district of New South Wales united by their lodges to form the Colliery Employés' Federation as a legal entity under the Arbitration Act, so that the machinery of the Act might be made applicable. The employers founded a similar union. The Arbitration Court was called on to give an award on disputed points between these two bodies, and it complied with the application, the award settling, *inter alia*, a rate of 1s. 9d. per ton as a hewing rate. The owners and miners were free to contract on the basis of the award. In January, 1903, the miners of the Rhondda Lodge—one of the lodges of the Employés' Federation—being dissatisfied with the above rate, threw down their tools without notice, struck work, and rendered idle the mines of Messrs. Smeddon and Laidley, Ltd. These owners, parties to the award, proceeded against the Federation for penalties fixed in the award. The proceedings were conducted in the Arbitration Court, and it was admitted during argument that the officers of the Federation had tried to dissuade the particular lodge from acting as it had done, and had reprobated the strike; also, that it was customary in the case of contracts in that industry that fourteen days' notice should be given in order to enable a master or a miner legally to terminate the contract of service. The Court held that, as regarded the Federation, no breach of the award had occurred. The fact that the officers of the Federation, immediately on learning of the resolve of the Rhondda miners to strike, had endeavoured to get them back to work, was held to be conclusive that the Federation was not liable. There remained the miners of the Rhondda Lodge to be considered.

The various points settled in and provided by the award had been observed. But the award had not made any provision to compel a continuance of the contract under the terms of the award. However, as the miners had struck work without giving the usual fourteen days' notice, they would be liable to prosecution as strikers under a provision of the Arbitration Act. The position caused by this decision was not, to say the least, such as was to be expected from the work of a Court whose business it was to bring about a state of permanency in industrial matters. The expense and labour of finding an award were thrown away, as, on the judgment, it was in the power of either of the parties to terminate its contract under it by giving fourteen days' notice of its intention.

Another case serves to show that the very men who invoke the mediation of the conciliation tribunal are not always prepared to accept its decision as final.

In the early part of 1904 the Newcastle (N.S.W.) Coalminers' Federation, consisting of a group of local trade unions, applied to the Court for a readjustment of the hewing rate. The employers, of course, were represented at the hearing of the application, which resulted, to the chagrin of the applicants, in a reduction of the rate. The men at two mines at Teralla, members of one union, immediately went on strike, in spite of the advice of their own officials. The strikers were theoretically liable to a fine or imprisonment for defying the decision of the Court; but it was impossible to enforce the fine, because both the men and the union were without funds.

These instances are of long ago, and it may be the fact that since 1904 many decisions of the compulsory courts in Australia and New Zealand have been duly observed on both sides. It is possible that in many cases working men will accept and abide by the decision of an impartial court which has reduced wages where a reduction merely decided upon by employers will not be accepted.

At all events, we should like to see the experiment tried in this country. It would not be expensive. It might be successful—or it might at least be an improvement upon the existing order of things. While no statesman has proposed any legislative measure dealing with this question, various suggestions have been made. The most recent is one which was made a year or two ago by the President of the Solicitors' Managing Clerks' Association. This gentleman made various proposals, which, although a little nebulous, are by no means unworthy of serious consideration. The main points of his suggestion are: (1) That all disputes between employers and employed, whether in a trade or a profession, concerning wages or conditions of service, should be included in the term "Industrial Disputes." (2) That either party to a dispute should be entitled to have it referred for determination to a permanent tribunal to be established under the Industrial Courts Act, the tribunal to consist of *three members of acknowledged impartiality*. (3) That if both sides agreed to a special tribunal nominated by themselves, the dispute should be referred to that tribunal which should be subject to the same rules and its decisions should have the same effect as those of the permanent tribunal. (4) That any society of employers or employés, representing one-half or more of the persons employed in the industry, or in the section of the industry in which the dispute arose and within the area covered by the dispute, should have power to refer the dispute to the permanent tribunal.

(5) That the decisions of the tribunal should be binding on all employers and employés within the area of the dispute, which should be defined in the award, *and any union disobeying the award should be deprived of the protection afforded by the Trade Disputes Act*, 1906. (6) That after such reference, no strike or lock-out should be lawful, except for the purposes of enforcing the decision of the tribunal. (7) That the tribunal should have power to make its decision retrospective to the date of the reference of the dispute, and should also have power to enforce the attendance of witnesses and the production of books, &c., to enable it to arrive at a just conclusion. (8) That the tribunal should have power in special cases, such as old age or partial incapacity, and upon such terms as it should think fit, to exempt any individual from the operation of an award. (9) That the proceedings of the tribunal should be public except where both parties to the dispute desired that the court should sit *in camera*.

Mr. P. F. Froud, who was responsible for these interesting suggestions, made one which, so far as the writer is aware, is entirely novel. He would deprive any trade union which fails to acknowledge the authority of the Court of the benefit of the Trade Disputes Act. It may well be that the prospect of being placed without the pale of that Act—a measure to which the large powers now enjoyed by the unions are almost entirely due—would have a very considerable influence in making them abide by the decrees of the Court. Whatever view may be held as to the wisdom of even attempting to settle trade disputes by compulsory arbitration, it is manifest that unless the element of compulsion is continued until judgment the whole scheme must fail.

PENSIONS FOR WORKERS.

[Communicated.]

Not the least attractive of the conditions of Government and municipal service is the payment of pensions under certain conditions to permanent employés. The gradual acceptance by employers of the view that they have a social obligation towards their workers has led to many inquiries being made of the Industrial Welfare Society, of 51, Palace Street, Westminster, S.W.1, regarding the possibilities of inaugurating superannuation schemes, and the Society has prepared an interesting Memorandum for the general guidance of firms which have this subject under consideration.

Many schemes having innumerable variations have already been adopted, and the suggestion set forth in the Memorandum deals only with the general methods which can be employed to build up a fund. The subject of Life Assurance is also touched upon, because in many cases it has proved advantageous to make provision in the same fund both for superannuation and for life assurance. In addition, brief mention is made of group assurance which has been largely adopted amongst big firms in America.

The difficulties attached to the adoption of a superannuation scheme by the ordinary industrial firm are inherently greater than those which apply to the pension scheme of a Government department or a municipality. Although pensions paid by the latter are often considered as being in the nature of deferred pay, such pensions have the security of the payer of rates and taxes, whilst on the other hand, the industrial firm is subject to the possibilities of fluctuating trade and the keenness of competition affecting profits, with their consequent effect upon the security both of employer and employé.

In considering the possibility of a scheme, a contentious point at once arises: whether pension funds should be contributory or non-contributory. Many examples of both methods are in operation, the former being in a majority—in which case it is a common practice for the employer and the employé to contribute an equal proportion—generally an amount representing about 4 per cent. of the employé's wages—the employer contributing an equal amount.

The proportion of wages payable by different trades varies to a considerable extent, and if a fund is established the cost of production is increased to that extent, but where a firm forms its own fund, the Government grants concessions which are not enjoyed by an assurance company, thereby reducing the amount payable by the firm without detriment to the employé.

In the first place, that portion of the cost borne by the firm by way of contribution is allowed as a working expense, provided such portion is paid by annual or regular contributions. If the contributions are irregular, the Government may either treat it as an expense at the time of payment or spread it over a period of years. In the second place, the interest on the fund is allowed to be free of tax, or, in other words, if the money is invested at, say, 5 per cent., the gross interest is added to the fund each year. A further concession provided by Section 32 of the Finance Act, 1921, is that a firm, or the employés of the firm, may form a scheme of life assurance under the Friendly Societies Acts, when the interest on the fund will not be subject to income tax, provided the sum payable at death or on the attainment of a specified age does not exceed £300 in any individual case.

Details of two schemes are given in the Memorandum. Under scheme "A" pensions are paid on a scale which is governed by length of service and salary on retirement, the pensionable salary being generally the average salary or wage received during 5, 7, or 10 years immediately preceding retirement. The pension may be one-sixth of the salary for each year of service, with a maximum of one-half or two-thirds of the retiring salary, or, in the case of unskilled or semi-skilled wage-earners, of, say, 30s. per week. A retirement age of 55 years is generally fixed, with power to extend the age limit in exceptional cases.

If an employé is compelled to retire through a complete breakdown of health, the before-mentioned scale applies if a certain number of years' service have been completed. If less, the payments made, with interest thereon, are paid over or applied towards maintenance. Where an employé leaves the service of the firm, it is usual to return the contributions, with interest.

Should death occur before superannuation, contributions, with interest, are generally returned. If after superannuation the balance, if any, between the contributions and the superannuation paid, is handed to the beneficiaries.

Scheme "B," which is sometimes adopted, is known as the "money purchase" scheme of superannuation. The principle is that each year's contribution goes to purchase a certain amount of pension, and the total pension is the sum of the various amounts of pension secured by each year's contribution. Such a scheme can be adopted in the case of a firm having a profit-sharing arrangement with its employés, and if in some years a large surplus is available, the surplus, with the contributions of employés, can be applied to purchase substantial additions to the future pensions payable.

Schemes can be inaugurated in conjunction with an insurance company, many of which are now prepared to issue policies, but where a firm forms its own fund, one of the most important questions arising is the posi-

tion of the fund if the firm goes into liquidation, as the trustees of that portion of the fund invested in the business would only rank as ordinary creditors in the liquidation. Due to this possibility, it is usually advisable that funds should be invested in trustee securities, or, if left in the firm, invested in the form of a secured loan. In the case of a public utility company, or where the probability of failure is not very great, there does not appear to be the same risk attached to investment with the firm.

Group insurance is the practice of assuring through an outside agency, without medical examination, the whole body of employés or definite groups, this method giving a benefit that age or physical disqualification might prevent. A lump sum or the equivalent of a year's salary is paid to the beneficiary of an employé dying whilst in service. The average cost to the employer is about 20s. or 25s. per cent. of the sum assured, but group assurance has not been received with much favour in this country, though several firms have schemes in operation.

Many other important details could be dealt with, but sufficient has been written to prove that such schemes are worthy of consideration and, if possible to adopt, likely to prove beneficial both to employer and employed.

TRADE STATISTICS OF HOLLAND.

The following statement, showing the imports and exports of electrical and similar goods into and from Holland during the year 1922, is compiled from recently-issued statistics. The figures for 1921 are added for purposes of comparison and notes of any increases or decreases are given.

IMPORTS.

	1921. Florins.	1922. Florins.	Inc. or Dec.
Electric generators, motors, transformers and rotary converters.—			
Total	13,264,000	7,166,000	−6,098,000
From Germany	9,046,000	4,786,000	−4,260,000
,, Great Britain ...	740,000	577,000	− 163,000
,, Switzerland	2,328,000	912,000	−1,416,000
,, Belgium	315,000	362,000	+ 47,000
Wireless apparatus.—			
Total	565,000	676,000	+ 111,000
From Germany	269,000	417,000	+ 148,000
,, Great Britain	170,000	121,000	− 49,000
Telegraph and telephone apparatus.—			
Total	8,614,000	6,350,000	−2,264,000
From Germany	3,038,000	2,834,000	− 204,000
,, Belgium	1,064,000	2,247,000	+1,163,000
Other electrical apparatus and instruments.—			
Total	8,258,000	5,465,000	−2,793,000
From Germany	6,216,000	4,119,000	−2,097,000
,, Sweden	398,000	554,000	+ 156,000
,, Great Britain	419,000	203,000	− 216,000
Steam boilers.—			
Total	8,538,000	3,413,000	−5,125,000
From Germany	3,511,000	1,445,000	−2,066,000
,, Great Britain	4,061,000	1,760,000	−2,301,000
Portable generating sets.—			
Total	1,000	29,000	+ 28,000
Telephone cable.—			
Total	4,576,000	1,967,000	−2,609,000
From Germany	3,376,000	1,703,000	−1,673,000
,, Great Britain	1,079,000	231,000	− 848,000
Other paper-insulated lead-covered cable.—			
Total	6,332,000	2,999,000	−3,333,000
From Germany	5,887,000	2,771,000	−3,116,000
,, Great Britain	346,000	214,000	− 132,000
Other lead-covered cable.—			
Total	2,049,000	1,431,000	− 618,000
From Germany	1,355,000	1,210,000	− 145,000
Rubber-insulated copper wire or cable.—			
Total	1,326,000	1,196,000	− 130,000
From Germany	1,056,000	1,017,000	− 39,000
Copper wire or cable insulated other than with rubber.—			
Total	591,000	227,000	− 364,000
Steam engines and turbines.—			
Total	7,934,000	5,213,000	−2,721,000
From Germany	2,163,000	2,075,000	− 88,000
,, Great Britain	5,100,000	2,511,000	−2,589,000

EXPORTS.

Electric generators, motors, transformers and rotary converters.—			
Total	3,161,000	2,114,000	−1,047,000
To Germany	377,000	444,000	+ 67,000
,, Belgium	526,000	721,000	+ 195,000
,, Dutch East Indies ...	1,613,000	412,000	−1,201,000
,, Spain	53,000	147,000	+ 94,000
Wireless apparatus.—			
Total	226,000	335,000	+ 109,000
To Germany	*	48,000	*
,, Great Britain	*	72,000	*
,, Dutch East Indies ...	*	204,000	*
Telegraph and telephone apparatus.—			
Total	519,000	442,000	− 77,000
To Great Britain	48,000	161,000	+ 113,000
,, Dutch East Indies ...	234,000	184,000	− 50,000
Other electric apparatus and instruments.—			
Total	1,401,000	766,000	− 635,000
To Germany	122,000	124,000	+ 2,000
,, Belgium	73,000	66,000	− 7,000
,, Dutch East Indies ...	1,126,000	452,000	− 674,000
Steam boilers.—			
Total	2,029,000	1,709,000	− 320,000
To Dutch East Indies ...	1,501,000	1,492,000	− 9,000
Insulated copper wire and cable.—			
Total	2,898,000	2,085,000	− 813,000
To Belgium	210,000	253,000	+ 43,000
,, Great Britain	739,000	363,000	− 376,000
,, Dutch East Indies ...	987,000	605,000	− 382,000
,, Norway	200,000	136,000	− 64,000
,, Denmark	29,000	160,000	+ 131,000
Metal-filament lamps.—			
Total	22,101,000	22,313,000	+ 212,000
To Belgium	2,019,000	1,350,000	− 669,000
,, Great Britain	2,175,000	1,134,000	−1,041,000
,, France	3,822,000	5,109,000	+1,287,000
,, Italy	3,141,000	2,665,000	− 476,000
,, Spain	1,541,000	918,000	− 623,000
,, Argentina	2,168,000	2,723,000	+ 555,000
,, Brazil	592,000	959,000	+ 367,000
,, Canada	735,000	893,000	+ 158,000
,, Australia	919,000	1,263,000	+ 344,000
,, Dutch East Indies ...	875,000	260,000	− 615,000

(Florin or Guilder=about 1s. 8d.)

The Tramways and Light Railways Association.—The headquarters of the Association for the fifteenth annual congress, June 21st and 22nd, will be at the Hotel Metropole, Swansea, but accommodation has been reserved at three or four other hotels. Delegates will have the opportunity of travelling in reserved coaches from Paddington on June 20th.

Following the annual general meeting on June 21st, Mr. A. W. A. Chivers will read a paper entitled "Tramways: and Some of To-day's Problems." The Swansea Tramways Co. will entertain the visitors at a luncheon, and for the afternoon a motor trip to the Gower Peninsula has been arranged. In the evening there will be a dinner at Hotel Metropole.

On June 22nd, Mr. W. E. Ireland, O.B.E., will read a paper on "Tramway Rolling Stock," the afternoon will be devoted to motor tours, and in the evening delegates will be the guests of the British Electrical Federation at a banquet at the Hotel Metropole.

Diesel-electric Ship Propulsion.—The first of the three electrically-driven ships ordered in England by the United Fruit Co., of Boston, was launched on April 17th by Messrs. Cammell Laird & Co., Ltd., at their Birkenhead yard. The *La Playa* is to be propelled by 4-cylinder Diesel engines, directly coupled to d.c. generators, and her speed will be 14 knots. Great economy in cargo space is said to be effected by the adoption of this type of machinery.—*Daily Mail.*

THE X-RAY EXAMINATION OF MATERIALS.

By A. G. WARREN, M.Sc., M.I.E.E., F.Inst.P.

(Abstract of lecture delivered before the Institution of Electrical Engineers.)

The inspection of metals by X-rays is designed to detect faults, lack of homogeneity, flaws, cavities, foreign materials, bad workmanship, &c. It can be applied to sealed bodies which it is undesirable or unsafe to dismantle—as shells. Such work demands quite commonly the "hardest" or most penetrating radiations that can be obtained, and the application of the method is only limited by the construction of tubes and subsidiary gear to withstand and produce the pressures that are required. The energy of a ray is given by the expression $h\nu$ where ν is the frequency and h is Planck's universal constant. X radiation is distinguished by the relative greatness of the quanta involved and is produced in the X-ray tube by the rapid deceleration of electrons of considerable energy. An electron hurled against the target is brought to comparative rest in a succession of atomic impacts giving out an X-ray at each. Much of the radiation produced suffers continuous degradation in the body of the target, but a certain small amount escapes and is represented roughly in distribution as shown in fig. 1. The short wave-length limit is defined by Planck's equation $h\nu = \text{E}e$, or in practical units $\lambda_{min} = 12{,}400/\text{E}$ The Angstrom units. limiting hardness of the radiation is defined by the voltage E. For the voltages being used the wave lengths are very short—about .06 to 12 Angstrom units, or of frequencies some thousands of times as great as those of visible light. Under suitable conditions radiation which is characteristic of the atom bombarded is obtained. Or, when radiation traverses a material, absorption may occur which is characteristic of the absorbing atom. The effects are almost exactly analogous to the emission and absorption of line spectra in light, brought

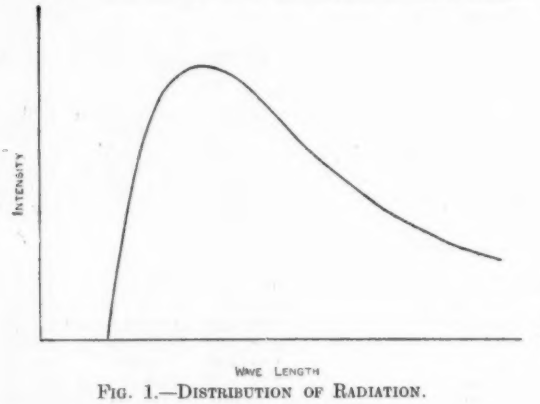

Fig. 1.—Distribution of Radiation.

about by exchanges of electrons between the various orbits or conditions in the atom, with this difference—that the orbits involved in X-ray phenomena are those next to the nucleus. These are normally full and phenomena characteristic of the inmost or K ring can only succeed the complete ejection of an electron from this orbit, clear of the atom. The result is that K characteristic actions only become possible when the atom is bombarded by a quantum of greater intensity than that associated with the K orbit. Line emission can then take place; absorption of radiation of higher frequency than the K limit is also possible. Fig. 2 shows the characteristic radiation emitted by a molybdenum target at 28,000 volts.

In the radiography of metals it may be assumed that voltages in excess of the K quantum limit are always used. (The critical voltages for iron and lead are respectively 7,100 and 90,000). If a beam of monochromatic radiation of intensity I_e fall upon a homogeneous substance it will suffer the same fractional absorption for each unit of distance traversed. The intensity I_x at a distance x below the surface will thus be $I_e\ e^{-\mu x}$ where μ is the fractional fall of intensity per unit distance. It is usually more convenient to use the mass absorption coefficient μ/ρ, instead of μ, ρ being the density. The absorbed radiation may be divided into two parts, a fraction σ which is scattered per unit distance, unaltered in frequency, and a fraction τ which is transformed and degraded, re-appearing as radiation of different frequency—heat, fluorescent radiation, and corpuscular radiation—so that $\mu/\rho = \sigma/\rho + \tau/\rho$. In general, it may be assumed that in comparatively low-voltage work the transformed radiation is greater than the scattered radiation, but that the order is reversed at greater penetrations. Except for very hard radiations the absorption coefficient may be expressed as: $\mu/\rho = a\lambda^3 + b$ or $c/\text{E}^3 + b$.

Turning to the actual problem of radiography, it has to be considered how the properties of the rays must be used to obtain the best result. The object to be radiographed is placed between the tube and the plate. The denser portions throw deeper shadows than the lighter parts. Only those rays which pass through unaltered and undeviated contribute to the production of an effective image. All scattered radiation which penetrates only helps to fog the plate and mask the image. Surface scratches on a block of metal, producing only the minutest variation in thickness, show up quite distinctly on a radiograph. If a scratch upon a piece of material, or a flaw in the interior be equal to a reduction of the thickness from D to $\text{D} - d$ the strengths of the emergent beams are $Ie^{-\mu\text{D}}$ and $Ie^{-\mu(\text{D}-d)}$. The ratio is $e^{\mu d}$. That is to say, it depends only upon the absorption in a layer of the same thickness as the scratch or flaw and not at all upon the thickness of the metal. The absorption can theoretically be controlled at will by varying the voltage on the tube. When the voltage is small μ is big and so great contrast is theoretically obtained with low voltages. In practice excessive exposures would be required if D were big, and to render the exposure reasonable μ must be decreased by increasing the voltage. Moreover, there is always a certain amount of scattered illumination on the plate, and although this decreases with reduction of voltage it does not fall so rapidly as the direct illumination. The contrast is, therefore, actually expressed by the ratio $Ie^{-\mu(\text{D}-d)} + s$ to $Ie^{-\mu\text{D}}$

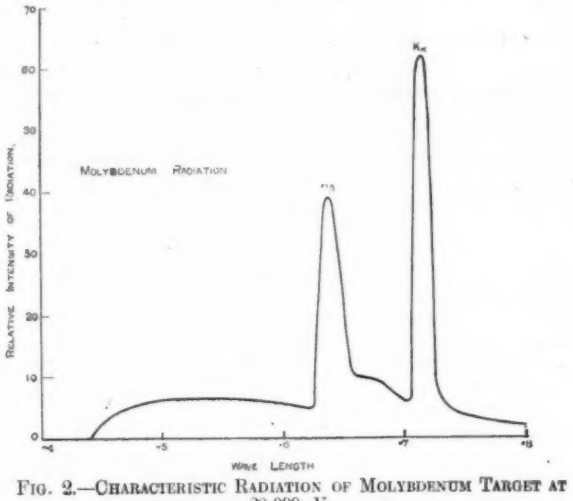

Fig. 2.—Characteristic Radiation of Molybdenum Target at 28,000 V.

$+s$, which becomes unity when $\mu=0$ or infinity. The optimum voltage increases with the mass of matter to be penetrated.

The problem facing the radiographer resolves itself into two parts:—(i) eliminating as far as possible all radiations which are not directly contributing to the formation of the image; and (ii) making the plate as sensitive as possible to the hard radiations. With regard to the first part, if it is desired to radiograph an object which calls for a moderate penetration, using rays which are projected vertically downwards, the plate is first placed on a thick shell of lead—this is to absorb radiation which passes through the plate and to prevent the fogging of the latter by scattered radiation from below. The object is then placed upon the plate and if it is regular it is completely surrounded by lead so that no radiation can possibly reach the plate except through the object. If the body is irregular it is mounted on plasticine which is trimmed flush with the edge, and lead dust to a depth of several millimetres is distributed round it. The exposure is then made. (For higher penetration a lighter backing such as iron will often give better results.) Much reduction in exposure can be effected by the use of intensifying screens and by increasing the absorptive power of the plate or film (fig. 3). Thin films are of little use; rays which have penetrated 2 in. of steel are rather scornful of two mils of emulsion. "Duplitised" films having a layer of emulsion on either side are commonly used. Oxides of lead and thorium are often added to the silver bromide to increase the absorptive power of the emulsion. In addition, intensifying screens of calcium tungstate placed in contact with the film produce a similar effect. The modern "Impex" plate is practically a combined plate and screen; the latter is dissolved off after exposure. It is also common to place a sheet of tinfoil immediately behind the film.

As has already been indicated, the greater the mass of substance to be penetrated, the higher is the optimum voltage

for good definition. It is commonly stated that 3 in. of steel is the practical limit of penetration but that is a conservative estimate. If greater thicknesses are to be penetrated the voltage must be increased so that the amount of radiation penetrating the material remains constant.

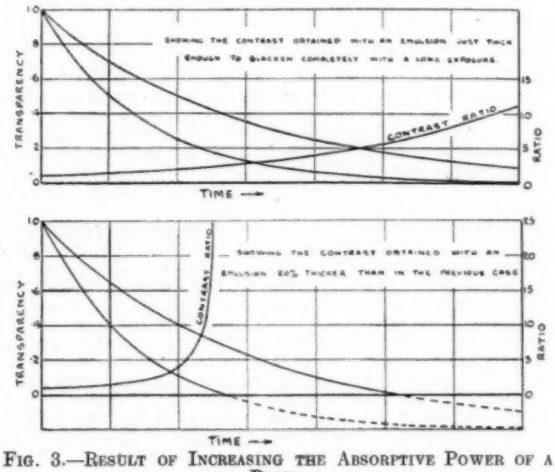

Fig. 3.—Result of Increasing the Absorptive Power of a Plate.

As examples of the penetration of metals X-ray photographs are reproduced. Fig. 4 shows a bad weld, and fig. 5 illustrates the irregular construction of a brass ingot.

For the production of X-rays a source of electrons and a source of high potential are required. Two methods are in common use for the production of electrons: (i) their evaporation from a hot filament, as in the Coolidge tube; and (ii) the bombardment of the cathode by positive ions, as in the gas tube. The pressure in a gas tube is never very low—about from 1 to 10 bars. The relation between the voltage across and the current through a gas tube depends very largely on its state of exhaustion and the "hardness" of the tube varies considerably. The voltage and the current cannot be varied independently. Modern technique demands, in general, the more controllable hot-cathode tube, in which the electrons are provided by an incandescent tungsten filament. The vacuum is much better than in a gas tube. The current in the tube is controlled entirely by the filament temperature and is independent of the voltage at which the tube is worked. In the standard Coolidge tube the target is a solid block of swaged tungsten. This may be worked white hot in the tube, when it can dissipate over a kilowatt by radiation continuously. The electron emission from the target is considerable, and all inverse voltage must

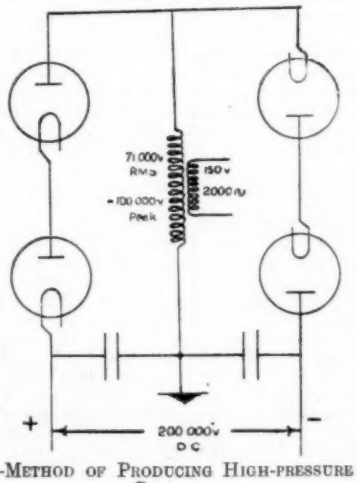

Fig. 6.—Method of Producing High-pressure Direct Current.

be suppressed, otherwise electrons are driven in streams of high velocity to the glass, quickly cracking it.

In a gas tube the focal spot is likely to wander and to depend in size upon the state of the vacuum and the voltage across and current through the tube. It is, in fact, largely controlled by the space charge, which, in ionic conduction, is positive. A positive space charge tends to open out the cathode stream. In the Coolidge tube the space charge is negative and the glass differs only slightly in potential from the cathode until the anode arm is reached. The space charge is far more definitely related to the load on the tube than in the gas tube, and the size of the focal spot can be accurately predetermined by the position of the filament in the hood.

The biggest problem in the electrical equipment is the high-pressure supply. A steady d.c. voltage is required but can rarely be obtained. It is extremely desirable that for the period during which the pressure is applied it should be maintained as close to its maximum value as possible. Any pressure lower than the optimum voltage for the work in hand produces heat with little radiographic result. When the voltages are very low, say for spectrometric work, batteries or a d.c. generator may be used, but a limit is soon reached in this direction, and the direct generation of d.c. cannot be considered at present for general work. High-pressure electrostatic machines have been used for low-current tubes, but at present they are not very practicable. For small powers the induction coil is perhaps the simplest solution. It involves no running machinery except the turbine interrupter, but when that has been said there seems to be little remaining in its favour, as the voltage is extremely variable; on no load the inverse approximates to the forward pressure and on load exceeds it. Undoubtedly the best solution up to the present is based upon the method used for obtaining a d.c. supply in radio work, *i.e.*, by charging condensers from an a.c. supply rectified by thermionic valves. The simple but ingenious connections used by Coolidge and Hull are shown in fig. 6. This system involves four kenotrons, each capable of withstanding 100,000 volts, their filament transformers, and high-pressure condensers capable of withstanding 100,000 volts each, in addition to a 2,000-cycle alternator. Such an outfit is expensive, comparatively inefficient, and costly in

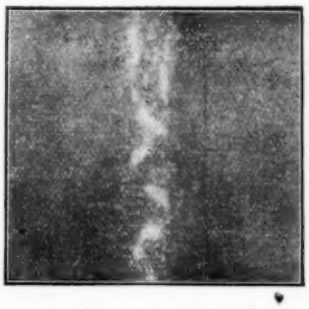

Fig. 4.—A Bad Weld.

Fig. 5.—A Brass Ingot.

renewals. In addition, the number of high-potential points is very considerable. For some time, at any rate, the most general outfit will consist of the absurdly-named "interrupterless" machine. This is simply a high-pressure transformer with a mechanical rectifier. The function of the latter is not only to rectify the h.p. current, but in addition to connect the transformer to the tube only near the peak of the voltage wave. The rectifier may be driven by a synchronous motor, but the system works better when an inverted rotary is used for the l.p. a.c. supply with rectifying disks fitted on the rotary shaft. The transformer, the output of which is rectified in the manner indicated, does not give uniform potential across the tube. High-frequency oscillations of considerable amplitude are produced. Two transformers have been designed and constructed in the Radiological Laboratory at Woolwich Arsenal. One is designed to give 30 milliamperes at 150,000 volts continuously (X-ray rating). A transformer of this size would be capable of giving 9 kilowatts continuously under ordinary a.c. conditions.

For a great deal of future work it may be possible to construct the whole outfit as one unit. The transformer need have no expensive terminals but can be connected through its rectifier to the tube working in oil. The set can be reduced to a box with a pair of terminals, to which 250 volts will be applied, and X-rays will pass through a suitably disposed aperture. The voltage control may be effected by either an auto-transformer or by resistance in the primary circuit. The lecturer is inclined to favour a combination of the two methods.

In conclusion, the lecturer considers that at the present moment the X-ray tube is a very useful appliance within its limits and research will extend the field of application very considerably. Critics of X-rays will never be satisfied; having asked for the penetration of six inches of steel and obtained it, they will ask for 12-in. penetration. The lecturer thinks that they will get the 6 in., and probably 12.

Acknowledgment is made of the assistance received from the Director of Radiological Research and others at Woolwich Arsenal.

STUDIES FROM A WIRELESS LABORATORY.

By W. H. ECCLES, D.Sc., F.R.S., M.I.E.E.

(*Being the substance of an evening discourse delivered at the* Royal Institution of Great Britain.)

The studies pursued in a wireless laboratory are mainly of two kinds: first, those directed to the solution of problems that have arisen in the development or use of practical apparatus, and, secondly, those aiming at the application of novel principles or novel physical phenomena to the invention of new methods or apparatus. This discourse has to do with the latter, and attention will be devoted to some possibilities tested in the laboratory, but not yet tried on the large scale. The new methods to be first described are based upon the phenomena, not yet fully known in detail, which occur when one vibrating thing is caused to influence the vibrations of another thing. For the study of vibrations slow enough to be followed by the eye a new type of oscillator has been constructed and is here exhibited for the first time, fig. 1 being a diagrammatic plan of the apparatus. The horizontal magnet has a horizontal ebonite rod fixed to it at right angles, and the whole is suspended from a vertical torsion wire passing through the centre of gravity. The poles of the magnet confront two horizontal solenoidal coils connected in series with each other and with a battery and diode valve. Such a valve possesses the property that the electron current across the vacuum is sensitive to outside electrical influences if the electrodes have suitable relative positions—an ebonite rod charged by rubbing causes a diminution of the electron current when it approaches the diode and allows the current to increase again when it recedes. The master suddenly drags the servant into time and the throbbing ceases. If the movement of the condenser is continued the natural period of the electric oscillator is carried through and beyond resonance, and finally the servant breaks away from the master and the throbbing indicating their difference of frequency begins anew.

The preceding experiments have carried us from vibrations at two per second to vibrations at 200 per second. We now pass to the problem of accordance when the vibrations are of a frequency of 200,000 per second. The electrical oscillator exhibited comprises a triode, an inductance, and capacity substantially as in fig. 3, though of very different magnitudes. The detecting apparatus is an inductance coil and a variable condenser connected to a crystal detector, just as in many a household crystal apparatus is used for listening to broadcasting stations. A galvanometer is connected to the crystal and a spot of light moves on the screen when the condenser is varied while the triode apparatus is in action. When a maximum deflection is found the receiver is in tune with the triode oscillator. Another triode oscillator is now substituted for the first and varied in frequency until in tune with the crystal receiver. Clearly both triode oscillators are now of approximately the same frequency. Let them both be put into action simultaneously so as to act upon the crystal circuit, and let a pair of auxiliary coils, connected in series, be so placed as to confront the respective triode oscillators in order to establish a linkage. The crystal circuit is receiving energy from both of the triode oscillators and actuates the galva-

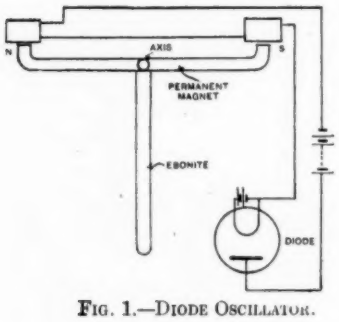

Fig. 1.—Diode Oscillator.

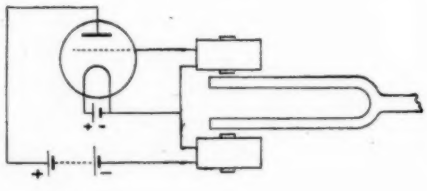

Fig. 2.—Triode-sustained Tuning Fork.

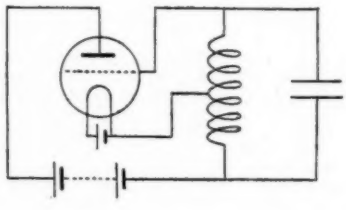

Fig. 3.—A Good "Servant" Oscillator.

action of this diode-sustained pendulum is now easily explained by supposing it to be swinging and noticing that the ebonite rod as it moves to and from the diode causes an alternation of magnitude of the currents in, and the magnetic fields of, the coils, which is automatically in correct time relation to assist the motion of the magnet. By means of a small mirror fixed to the magnet and a lamp and scale, the building up of the motion from a small initial amplitude is easily seen.

With two such pendulums the accordant state can be studied by eye observation. Dr. Winifred Leyshon, who arranged the apparatus for exhibition, is engaged upon this task. As arranged for the investigation one of the pendulums is made the master by sending some of its current through an auxiliary winding influencing the magnet of the other pendulum. The frequency of either the master or of the servant pendulum can be varied by the aid of a movable permanent bar magnet placed near the oscillating magnet. As one natural period becomes nearly the same as the other the master catches hold of the servant, compels it to abandon its own natural period and to move in time with the master's—though not necessarily in step. The amount by which the servant is out of step depends upon the difference of the natural periods, and therefore can be regulated. It is also possible to use vibrators of acoustic frequency, and so make the according process evident to the ear. A tuning fork sustained by a triode is very effective as the master oscillator.

Fig. 2 shows that when the fork is vibrating the induced electromotive force acting upon the grid controls the anode current so as to sustain the motion. On the other hand, an electrical oscillation which is independent of moving matter, makes a good servant oscillator. Its circuit is shown in fig. 3. The linkage between the two oscillators is effected by passing some of the current from the fork coils through an auxiliary winding on the electrical oscillator. The electrical oscillations can be made audible by inducing currents in another circuit containing a loud-speaking telephone, and their frequency can easily be altered through a semitone or more by varying slightly the capacity of the condenser shown in fig. 3. Now, as the natural frequency of the electrical oscillator approaches that of the fork loud throbbing (called "beats") is heard, which becomes gradually slower until at a certain point the nometer. The accordant state is then easily found by varying one of the oscillators very slowly and watching the spot of light. At the moment when the two oscillators come within a certain frequency difference they suddenly pull into time and the spot of light gives a sudden kick. This phenomena was discovered by Dr. J. H. Vincent, and one of his curves is reproduced in fig. 4, which shows that as the condenser of one triode oscillator is increased the galvanometer in the crystal circuit shows, first, an increase, and then a very sudden decrease of deflection. The nearly vertical parts of the curve are due to the establishment of accordance. In a rough way one may explain the phenomenon by saying that at the lowest point of the curve, where there is a sharp cusp, the two oscillators, although they are vibrating in time with each other, are oscillating oppositely; in fact, one oscillator is moving like the front legs and the other like the hind legs of a walking dog whose fore and hind legs are in time, but not in step, with each other. The curve and experiment show that a very minute variation of the condenser of either oscillator makes the deflection increase enormously.

There are several ways of applying this novel phenomenon to wireless telegraphy: Suppose one of the two oscillators to be a distant transmitter, the waves from which are picked up by a receiving station the antenna of which is coupled to a local oscillator in the relationship of master, and let a tuned detector circuit be acted upon by both the antenna and the local oscillator. Then suppose the local oscillator to be adjusted until it is in the accordant state with the antenna oscillations and, in fact, adjusted until the detector current is at the minimum value corresponding to the cusp of the Vincent curve (fig. 4). It then follows that a very minute variation of the frequency of the oscillations emitted by the distant station will give rise to a deflection of the galvanometer. It is suggested that signals could be transmitted by up and down changes in frequency—such changes would be far smaller than the changes of frequency employed by the accepted methods of the present day—and thus the interference between stations would be minimised. There are many easy ways of producing small changes of frequency at the transmitting station.

Another and very different method of signalling may be

illustrated by the same apparatus, after again adjusting the receiving apparatus to the minimum deflection obtained in the accordant state. It is possible to bring the spot of light to any desired point of the scale—that is, to any desired point on the vertical portion of the Vincent curve—by appropriate adjustments of the frequency of the transmitting unit. The latter adjustments are for this purpose conveniently effected by the motion of a short-circuited coil of wire near the inductance coil of the transmitting oscillator. Therefore, to every position of the auxiliary movable coil at the transmitter there corresponds a position of the spot of light actuated by the receiving apparatus. It has been found possible to mark the scales at each place with an alphabet and so communicate intelligently without the aid of the Morse code in the laboratory.

The above-described methods of signalling are based on the discovery and application of the accordant state. Another distinct series of methods depends on the fact that the combination of two high-frequency electrical vibrations of slightly differing frequencies yields a throbbing amplitude which may

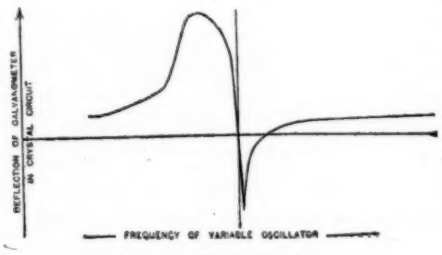

Fig. 4.—Vincent's Curve.

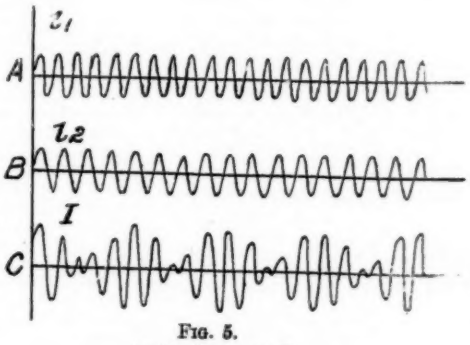

Fig. 5.

$t = 0{\cdot}1$; $i = i_0$; $I = 21$.
$n_1/n_2 = 250/200 = 1{\cdot}25$; $n = n_1 - n_2 = 50$.

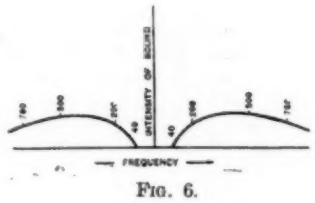

Fig. 6.

be made of audible frequency and of any desired pitch by adjusting the frequency of either of the original vibrations. The formation of relatively slow throbbings from two quicker oscillations is shown diagrammaticaly in fig. 5. The heterodyne method of receiving continuous waves utilises this principle in the following way: The transmitting station emits long and short trains of waves corresponding to Morse dashes and dots and of a frequency of, say, 200,000 per second. These waves produce in the receiving antenna feeble oscillations, which are combined with locally-generated oscillations of about the same strength and of a frequency of, say, 200,500 per second. The result is a compound high-frequency current with 500 throbbings in it per second, which, when rectified, can be heard in a suitably-connected telephone. The long and short trains of waves from the transmitting station thus give rise to sounds of long and short duration and of constant pitch, the pitch being adjustable by altering the local frequency from 200,500 to other values.

By altering this frequency from, say, 199,300 per second to 200,000, and then to 200,700, the sounds in the telephone run through a continuous scale of notes as represented in fig. 6, which starts on the left with a note of 700 that falls in pitch to about 40 and becomes inaudible, passes through resonance, becomes audible again, and ascends a scale in opposite order to the first scale. Thus a note of any desired pitch can easily be obtained, but the intensity varies on account of the varying sensibility of the ear and the apparatus.

This possibility of the variation of pitch makes a number of new methods of wireless signalling feasible. One of the easiest resembles the old moving-needle telegraph apparatus (Bright's bells) in which the needle moved to one side and struck a bell in order to indicate a dot and moved to the other side and struck a bell of different tone to indicate a dash. This method was faster than the dot and dash sounder and apparently easier to learn. In its proposed wireless form the transmitting station would emit equal wave trains to represent dots and dashes of, say, 200,200 frequency to represent the dots, and 200,500 frequency to represent the dashes. Each Morse sign is then heard at a receiving station using a local oscillator of 200,000 frequency as a little melody. Besides the advantages mentioned above there is a likelihood that these signals would be less distorted by atmospheric discharges than "longs and shorts" of constant pitch are.

Another simple method consists of utilising three very close high-frequency oscillations at the transmitting station, say 200,200, 200,100, 200,050, and making a new code for the alphabet out of permutations of these. The local oscillator would have a frequency of 200,000, and therefore the sounds heard in the telephone would be short tunes; the method would be faster than Morse, but might demand that the operators should have musical ears. Still another method can be imagined in which cords of three notes instead of arpeggios are used for the letters of the alphabet, but this might require an even more musical ear.

But there is one kind of chord which everyone can recognise without special training, which even the horse can discriminate in the sounds of "whoa" and "gee"; the vowel sounds are, in fact, chords. Lately Sir Richard Paget has given (Vowel Resonances, International Phonetic Association) a list of the chief tones occurring in the English vowels. For instance, the vowel sound in the word "calm" contains the tones of frequency 1,360 and 810 per second. Suppose, therefore, a transmitting station is arranged to emit simultaneously electric waves of frequencies of 201,360 and 200,810, and suppose these waves when received at a great distance are combined with local oscillations of a frequency of 200,000 per second. Then the tones 1,360 and 810 are heard simultaneously as a chord in the operator's telephones. But this chord by itself is scarcely, if at all, recognisable as a vowel; recognition is ensured by superposing a larynx note by the aid of a buzzing contact included in the receiving circuit. Then, whenever a train of two waves leaves the sending station the vowel is pronounced by the receiving apparatus, which is easily illustrated to an audience by the aid of a loud-speaking telephone. Lecture apparatus for producing and detecting the two vowel sounds represented by o, a, is shown in figs. 7 and 8. The change of radio frequency necessary for passing from one vowel to another is provided by the tappings on the inductance coils, and in practical telegraphy the transmitter and receiver would be provided with aerials.

The apparatus exhibited (which was built and made to work by Messrs. C. F. A. Wagstaffe and E. S. Smith, two former Finsbury Technical College students, was constructed to produce six vowels—namely, those heard in the words eat, all, hate, shoe, calm, and earth. These six vowels taken in pairs

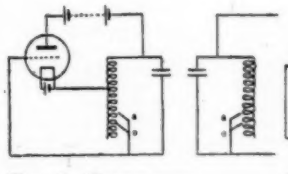

Fig. 7.—Transmitter.

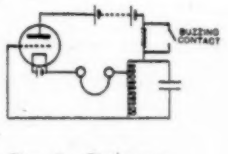

Fig. 8.—Receiver.

yield 36 symbols which, together with the five vowels a, e, i, o, u, representing themselves, amount altogether to 41 symbols. An alphabet formed in this manner is much briefer than the Morse code; that is to say, there are fewer efforts of the sending key in making the same message. For instance, in the word London there are 17 efforts when Morse is used, but only eight when the vowel code is employed. Besides the gain in speed there is a possibility of reception through atmospheric disturbances being easier with the vowel code than with the customary dots and dashes of constant pitch, but this can only be tested by actual trials.

The Rating of Machinery.—At a recent meeting of the Liverpool Engineering Society Mr. E. W. Pierce (solicitor) read a paper on the above subject. After a review of the legislation regarding the rating of machinery, commencing with a statute of Queen Elizabeth, the author spoke of the existing need for action, stating that no further investigation was necessary in view of the report of the Royal Commission on Local Taxation in 1901. This Commission's recommendations had been embodied in a Bill, but although this had been before Parliament on 17 occasions, passing its second reading nine times, it had failed to reach the Statute Book. It is to receive another second reading on May 11th. Mr. Pierce stated that no really forcible objections had been advanced against the principle of the Bill. The paper concluded with quotations from judgments given on the subject.

POSSIBILITIES OF UNDERGROUND TRANSMISSION AT 100/150 kV.

Discussion at Liverpool.

Major A. M. Taylor's paper on the above subject (an abstract of which appeared in our issue of December 15th, 1922) was read at the Mersey and North Wales (Liverpool) Centre of the Institution of Electrical Engineers on January 15th, 1923, and in the course of the subsequent discussion,

Mr. F. Mercer contended that the author's intersheath cable would be less efficient than a single-core cable having approximately the same cross-sectional area.

The following points illustrated some of the disadvantages of intersheath cable:—Capacity currents necessitated a very appreciable cross-sectional area of copper for the intersheaths alone. When used for conveying power, the intersheaths were operating at lower voltages than the central core, and transmitted correspondingly less power for a given amount of copper. Space occupied by the intersheaths might be usefully occupied by dielectric, and the permissible voltage gradient for the dielectric near the central core or the intersheaths was lower than for a single-core cable because a thin dielectric necessitated a higher factor of safety. The table of comparative costs given in Appendix E was difficult to understand, and it would have afforded a more valuable comparison if the estimates had been for the 6-phase/3-phase scheme of the author and a 3-phase single-core cable scheme, the operating voltage in each case being 100,000.

Mr. A. E. Malpas pointed out that the usual limit of the diameter of an armoured cable was 4 in., beyond which there was serious risk of cracking the insulation. It was very much to be doubted, therefore, whether such a cable with an intermediate lead sheath, as the author proposed, would not after having been rolled on and off the drum contain incipient cracks which might not be noticeable at, say, 45,000 volts, but which might easily lead to breakdown under the higher pressure, more particularly when the effect of surges was taken into account. An underground cable of equal length and voltage would increase the cost of power by 4.4d. per kWh, or nearly thirty times as much as if transmitted by overhead lines.

Mr. W. Holttum thought they were within sight of the limiting voltages of transmission by impregnated paper-insulated cables due to the limit of dielectric stress having been reached. The author's statement that by his system all the cores were utilised "equally for the passage of heavy-load currents without seriously diminished voltage on each circuit" was a vital point in the whole scheme, and the speaker contended that whatever was gained by redistribution of voltage gradient in the dielectric must necessarily be counterbalanced by a lower effective working voltage of a portion of the copper, and any apparent gain was entirely illusory. The method of jointing by having the end of the cable prepared in the factory prevented any adjustment of joint positions in laying, except by burying superfluous cable, and in some places this would be a serious inconvenience. The protection afforded by the extra sheath was apparently lost at joints, and, in addition, jointing would be difficult and costly. He commented in detail on the 12 conclusions in the last section of the paper, and suggested that they did not show very much in favour of the system.

Mr. T. D. Clothier was unable to make out where and how the fourth "major star" system was connected in or superimposed upon the two inner conductors in each of the three systems. The author did not compare the cost of his system with that of a straight 100,000-volt system with an earthed neutral using 57,000-volt single cables, presuming probably that such cables could not be manufactured. It was shown, however, in the paper that three sets of such cables, any two of which would be sufficient to transmit the power under consideration, would contain only 1.665 sq. in. of copper against 2.532 sq. in. in the author's six cables, and if this type of cable could be made, it would no doubt summarily dispose of any application of Major Taylor's proposals. The proposal seemed to be quite feasible and an advance on previous suggestions to use intersheaths for this purpose, but its commercial application depended largely upon the ability to produce reliable single-core cables capable of working at the same pressure without the intersheaths.

Mr. A. B. Mallinson referred to the admittedly low cost of overhead work, and thought there was far more scope yet in England for overhead mains. If the author's proposition was based on cables guaranteed for one year, there would not be much hope for it. He endorsed the remarks about the method of finishing off the ends of a cable, as it was utterly impossible for anybody to give the definite length of a cable to be laid underground. The induced currents in the lead sheathing considerably increased where the cable centres could not be kept within 6 or 7 inches, and the speaker could not see how the author could get his cables so close, unless they were laid on top of each other, which would be most unsatisfactory.

Mr. W. P. Fuller thought that Major Taylor had exaggerated the effects of temperature on cables. If the curves referred to a.c. resistivity, they must belong to somewhat old cables. A modern high-voltage cable could be made to have a very nearly constant power factor, and less than .01 over the working range of temperature; consequently, the dielectric losses were very nearly independent of the temperature. With regard to intersheaths, it was a mistake to aim at obtaining a uniform stress, because the breakdown of a dielectric was not altogether a function of the maximum stress. In general, as the diameter of the conductor increased, the stress must be reduced if the factor of safety was to be preserved.

Dr. E. W. Marchant said that it seemed very doubtful whether it would be worth while to try and diminish the current carried by the intersheaths by introducing auto-transformers at different points along the cable to supply the necessary charging current. If the intersheaths were used for conveying power as well as for equalising the pressure, the copper could not be used so efficiently as if the whole of the power were transmitted at the higher pressure. To obtain an accurate estimate of the merits of Major Taylor's system it ought to be compared with a 6-phase system of transmission, but without the special arrangement of intersheaths given by Major Taylor.

Mr. J. W. Warr came to the conclusion that the propositions were novel, and it would be folly for anyone to predict the results of such a scheme should it be adopted. He considered the system full of probabilities, but the title was not correct. In the new method, the single-phase transformers would only be designed for 0.7 power factor, and when they were subjected to an inductive industrial load of comparatively small magnitude, unless the electrostatic capacity of the cables raised the power factor, the consumer would be penalised in having to compensate more than he had to at the present time. They should not sacrifice too much in the direction of cheaper transmission if the new proposals were in any way to be complicated.

Report on Railway Accident.—Major G. H. Hall has reported to the Ministry of Transport upon a collision which occurred near Carlton Station on the Shildon-Stockton branch of the North-Eastern Railway on December 29th last year. In this case a loaded mineral train travelling from Shildon to Newport over-ran a signal and collided with an empty mineral train which was being crossed from one line to another. A great deal of damage was done to both trains, one of which, the loaded train, was being hauled by an electric locomotive, the other being drawn by a steam locomotive. The driver of the mineral train stated at the inquiry that he was misled as to the weight of the wagons coupled to his train. When he passed the signal, which was against him, he made an emergency application of the Westinghouse brake which, however, did not have the desired effect owing to the load being greater than he thought. The report places the main responsibility for the accident upon the driver, and recommends the placing of the crossing at a greater distance from the signals.

In an appendix to the main report, the Inspector deals with mineral traffic working generally on this line. He sums up the evidence given by drivers at the inquiry, and says that the results up to date speak well for the braking and other characteristics of the electric engines employed. He also makes recommendations with regard to braking.

A Barrel-lifting Electric Truck.—Different types of electric trucks are used by Messrs. Elder-Dempster & Co., Ltd., for handling palm oil barrels at the Liverpool Docks. With manual labour alone barrels make very awkward cargoes to handle, and the Elder-Dempster Co. has been making exhaustive trials of different types of electric trucks to obviate man-handling. A new truck has recently been adopted after exacting tests, designed and built by Messrs. W. Goodyear and Sons, Ltd., of Dudley, in conjunction with Messrs. Greenwood and Batley, Ltd., of Leeds, which will automatically lift a palm oil cask and deposit it in any desired position on the dock, the whole of the operations being performed by the driver without leaving the driving platform. When not required for the purpose of barrel lifting, it will carry a load of two tons on the platform and trail a gross load in addition. It is capable of a speed of 8 miles per hour on the level, and will work for 12 hours on one charge of the battery. The truck created a great deal of interest on its first appearance at the West Toxteth Docks in Liverpool.—*Electric Vehicle.*

A NEW RADIO DETECTOR VALVE.

Non-Interfering Liquid Electrode Type.

It is well known that the use of a 3-element detector valve in a radio receiving circuit employing reaction increases the sensitivity greatly, but that if reaction is carried beyond a certain limit considerable signal distortion results. Moreover, the adjustments are very critical and such a circuit, particularly when used by an inexperienced operator, interferes very much with neighbouring receiving stations.

It is, therefore, interesting to record that Mr. H. P. Doule, chief engineer to the Connecticut Telephone & Electric Co., U.S.A., has invented a non-interfering vacuum valve which, although it acts only as a rectifier, is claimed to be as sensitive as an ordinary 3-electrode valve when used in a reaction circuit. It is a radical departure from the conventional triode inasmuch as it employs a liquid electrode of sodium that is kept warm by means of a small resistance connected in series

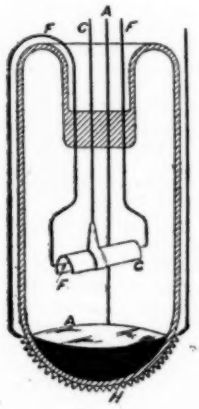

Fig. 1.

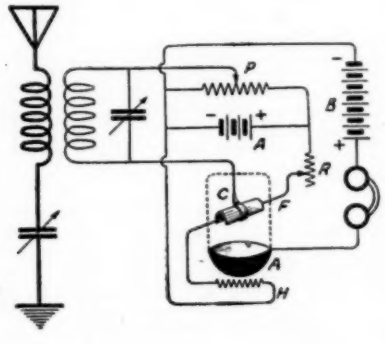

Fig. 2.

with the filament and cemented on the glass wall of the bulb as shown diagrammatically in fig. 1, the tube itself as well as the heating resistance being enclosed within another glass bulb.

According to *Modern Wireless*, to which we are indebted for the following information and illustrations, the new valve (which is the outcome of experiments with, particularly, detectors employing the ionisation of metallic atoms) is said to have none of the disadvantages of regenerative and gaseous detectors, and its method of operation seems to involve many interesting phenomena, which differ radically from those occurring in other types of valve.

From fig. 1 it will be seen that F is the filament; A the liquid anode in the bottom of the tube (which may be metallic sodium); and directly underneath this is the short heating wire H. The "collector" electrode C is a U-shaped metal sheet above the filament with its open side facing the anode.

In operation the valve may be in the circuit shown in fig. 2—simply a two-circuit tuner with one terminal of the secondary connected to the "collector" electrode C of the tube and the other to an adjustable resistance connected directly across the filament battery terminals. The remainder of the circuit is as used with any simple detector. The adjustment of collector potential is the only one necessary for efficient operation other than the usual variation of capacity and coupling of the tuning circuit. The potential of the battery B is not at all critical and usually may be varied between ten and thirty volts without much effect on response.

"As a detector this tube is remarkably sensitive, its adjustment is simple, and it is absolutely stable in operation. This extreme sensitivity is readily reproducible and permanent."

Note the resistance in series with the filament; the current consumption of the new valve is about the same as that of a standard valve. The new detector creates no noticeable distortion and, as it does not oscillate over its useful range, it cannot create any interference with other receivers. Furthermore, it is unaffected by small capacity changes, such as those produced by the operator's hand in tuning. The response of the valve is greatly improved by very weak coupling between the circuits, due to its very low input impedance, which also makes the proportion of capacity and inductance of the secondary circuit for the maximum results quite different from those for other tubes. Although the new detector can be used successfully in an ordinary two-circuit tuner, results will fall short of the maximum unless means are available for selecting the best value of secondary inductance.

In the new valve an electron flow takes place from the filament to the collector, the magnitude of this current being due in part to the relatively large area of the collector and to its close proximity to the filament. It therefore receives an equivalent of large electron flow when it is at the same potential as the negative end of the filament. In order to reduce this flow an opposing potential (which may be taken from the filament battery) is introduced into the circuit between the collector and the filament and is known as the neutralising potential; it is plotted as the abscissæ in the curves shown in fig. 3, which indicate the variation in the anode and collector currents Ia Ic with a variation of the neutralising potential En and also the collector current when the anode circuit is open I'c.

The curve labelled Ic−I'c represents the difference between the collector current with the anode circuit completed and opened, and it apparently takes into consideration various phenomena concerned in the operation of the valve, because its slope is practically a direct index of the merit of the valve as a detector.

Although some detection takes place at the abrupt bend in the curve when En = minus 1.8,* it is incomparable in magnitude to that secured at the sensitive portion of the slope, *i.e.*, when En = minus 1.4 volts, which is at a relatively flat portion of the collector current curve and considerably above the lower bend. Furthermore, a signal impressed on the collector circuit always decreases the collector current regardless of whether the characteristic curve at the sensitive point is concave or convex. Other items of interest are that the point of maximum sensitivity occurs somewhat above the middle of the Ic−I'c curve; that the value of the collector current at operating potential is usually from two to four times that of the anode current; and that large changes of current are produced by small changes of neutralising potential.

The change in collector current for impressed signals is indicated by fig. 4, which might seem to indicate a limited wavelength band of operation for this type of tube, but the entire shape and position of the curve depend upon the relative potentials of the electrodes and upon their proportions and relative positions. It is possible to change the curve radically by a simple variation of the neutralising potential; also, by properly selecting values, a serrated curve, fig. 5, can be secured which indicates obvious possibilities for the elimination of interference.

The ratio of the change of power in the collector circuit to the resulting power change in the anode circuit is approximately unity. This lack of amplification accompanying detection makes it feasible to operate the valve with the telephone receivers placed directly in the collector circuit, instead of in the anode circuit as shown in fig. 2, although results are not quite so good as with the normal circuit(fig. 2) on account of the interference caused in a low-impedance circuit by the high-resistance receivers. Such an arrangement might seem to be equivalent to a 2-element valve; it is not so however, for if the anode circuit is opened the device ceases to function.

When the filament is first lighted the anode receives a small amount of heat by direct radiation from the former

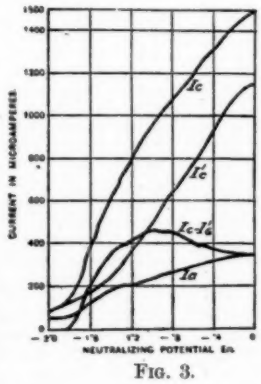

Fig. 3.

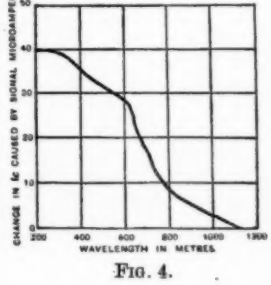

Fig. 4.

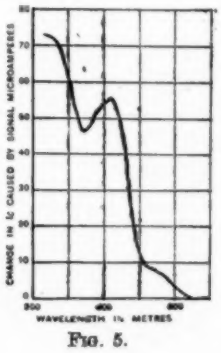

Fig. 5.

* In reproducing fig. 3 decimal points have been inserted in the abscissæ, which were apparently omitted from the original.—Eds.

and there will be, even at this relatively low temperature, a considerable emission from the latter. The emission will, however, decay with time, but the temperature of the anode is increased at an approximately correct rate to compensate for the decay by the external heater (fig. 1), and thus the anode emission becomes fairly constant within a few seconds of the valve being lighted; the result is that the device is in an operative condition almost immediately after it is lighted.

Ionisation controlled in this manner is extremely stable and the new valves may be maintained in their most sensitive adjustment for long periods of time—an impossibility with a gaseous detector. Also it is possible to manufacture the new valves in quantity with little, if any, variation of intensity and they will retain substantially constant sensitiveness throughout their lives.

CORRESPONDENCE.

Letters received by us after 5 p.m. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Welding Arc.

The criticisms passed by Mr. Langdon-Davies on my previous letter are extremely interesting, the more so as they are quite inaccurate.

In the theory of the arc there are two factors of outstanding importance:—

(1) That in the arc we have a case of unidirectional conduction; and

(2) That the a.c. arc has a synchronously pulsating resistance.

Mr. Langdon-Davies takes exception to the first of these statements, so that it would be as well to explain what is meant here by unidirectional conduction. When dealing with the possibility of an arc existing between electrodes there are two cases to be distinguished, according to the applied voltage; these are:—

(1) Rectifying arcs; and

(2) disruptive arcs.

It is only case (1) that we need consider here, *i.e.*, the a.c. welding arc falls entirely within the rectifying range. This does not imply that the a.c. voltage is rectified, as this is only done under the following conditions. Suppose that we have a body touched by the arc stream, and connected to a source of alternating voltage. Then this body is alternatively positive and negative towards the arc stream, and conduction only takes place during the positive half-wave. This is "rectification," with which Mr. Langdon-Davies has evidently confused "unidirectional" conduction.

It would be interesting to know whether Mr. Langdon-Davies has ever had any experience of even harmonics in his arc circuits. In the majority of arc oscillograms which I have seen the presence of these harmonics was clearly shown by a considerable lack of symmetry between the positive and negative half-waves. I ask this question because of Mr. Langdon-Davies's statement that "he has never seen a sufficient difference between the positive and negative half-waves."

Concerning the question of continuity, Mr. Langdon-Davies states that he said in his original article—"Notes on the Welding Arc"—that continuity was maintained by the residual vapour. On re-reading this article I find the following statement: "It suggests that . . . . continuity of the arc circuit is maintained by the vapour of a metal which vaporises at a lower temperature than iron." With regard to metallic electrodes, this suggestion was first made as the result of tests carried out in the Massachusetts Institute of Technology, and contained in the report read before the American Welding Society. But what happens in the case where there is not necessarily any metal present to vaporise, as in the case say, of carbon? My suggestion was that the continuity was maintained by *the residual vapour of the electrode material.*

The most important phenomenon associated with the arc is that of the synchronous pulsation of resistance. The result of this effect accounts for all the other statements which I made in my first letter. The phenomenon is shown in fig. 5 (resistance curve) of Mr. Langdon-Davies's original article, but here it must be remembered that this curve is continuous, and not broken, as shown. It might also be as well to mention here some slight modifications which are required in the voltage curve of the same figure. The first positive and negative peaks should be raised and lowered respectively, and this should also be done with the flattened portions of the curve, to bring them considerably below the level of the peaked values.

Mr. Langdon-Davies states once more that the wattless current of the arc is due to the regulating devices. This is not a statement that by a sufficient amount of repetition would at length convince us that it was true. The wattless component of current in the a.c. welding arc is entirely due to the pulsation of resistance, and in fact, *wherever we have such resistance pulsation we have, as a natural consequence, a wattless component.*

This pulsation of resistance, even with a sine wave of current, does not follow, even approximately, a simple sine law of double frequency, and therefore *the voltage wave is greatly distorted and high peak values are found* of the magnitude I mentioned in my first letter. Mr. Langdon-Davies states that he finds it difficult to imagine where such voltages could be generated in an ordinary a.c. welding circuit. The one reply to this is that they do exist, due to the above cause. Of course they might under certain conditions result as the consequence of certain relations of the circuits. They may, for example, be caused by magnetic saturation, &c. It must be remembered, in this connection, that, strictly speaking, voltage has no real existence, being only the electrostatic component of power, and is a very convenient fiction, similar to that of the imaginary quantity so useful in all a.c. problems.

Transient current peak values such as are suggested by Mr. Langdon-Davies can, and do exist, but of course only occur at each change of the stationary conditions of the circuit; but these voltage peaks are inherent in the arc itself and are permanent in the arc circuit. They are due to "the lower resistance of the residual vapour *immediately after the passage of the arc.*" Mr. Langdon-Davies evidently mis-read these last words in italics, which are essential to the sense of the statement.

Further, he states that "the resistance of the arc increases as the volts decrease." A little thought and an examination of the figure 5 referred to above will show that this is a very unwise generalisation to make.

T. W. J. Powell.

Barrow-in-Furness, *April 20th*, 1923.

The Training of Young Engineers.

With reference to the recent correspondence under the above heading, there is one point which has been overlooked by the various correspondents, *viz.*:—That although the scheme under discussion, while it will no doubt provide a good training in public electricity supply work, will not result in the trainees becoming engineers, as is suggested by the title given to the scheme. This should be obvious to anyone looking over this or similar schemes, as practically no provision is made for systematic workshop training which is the all-important part of a training for a young man who desires to be a really qualified engineer. It is true that a certain amount of repair and construction work is included in the course, but when one considers that the whole ground of the scheme is covered by a three-years' course, and the variety of subjects that are included, it is obvious that the practical workshop part of the training is likely to be of little or no value to the trainee. There is one place, and one place only, where a man can be trained as a real engineer, and that is in a workshop. The letter of "N. O. Chance" in your last issue shows this particular scheme up in a most serious way, as it is apparent from his remarks that the company in question has made its selection almost entirely from University students. Granted, that those selected may hold degrees, they are no more engineers than a policeman or a navvy unless they have had a systematic workshop training in addition. It would have been only reasonable to expect that the principal condition laid down for the candidates to comply with would have been that they must have served an apprenticeship in a recognised engineering shop before being eligible for the training the company can give them. By doing this, the promoters of the scheme would have obtained a better type of candidate, and one who when his training in electricity supply work was completed would be actually an engineer in the true sense and not a "half-baked" university or technical college graduate, who on completion of the training will, no doubt, have the colossal cheek to call himself an engineer. It may be argued in defence of the scheme that the men selected are intended for administrative positions; granted that this is so, it only makes the matter several times worse, as these men will then be taking on themselves to dictate to others who may be under them but who have had a legitimate training and who are engineers. In engineering work no man should be allowed to supervise the work of others unless he has been trained in and is actually capable of carrying out the work in question himself. University or technical college training in some form is necessary, but without the training received in a workshop it is worse than useless. As far as the form of technical training is concerned, it is quité possible for a man to obtain a sufficiently thorough course from any of the up-to-date correspondence schools now in existence. During several years past the writer has made it a rule when appointing assistants or engineers-in-charge to insist that candidates will only be considered who have served either five years in a workshop or three years in the shop and two years on outside erection or repair work. The more repair work the candidate has been engaged on the more likely he is to be of real use. Some years ago, the trouble was that there were not sufficient opportunities for technical training, but at present we seem to be suffering from too much of it, to judge by the number of blunderers and half-trained men who are going about styling

themselves engineers. Put a man of this type in certain positions abroad where one is generally many miles from an engineering shop of any sort, and see how he behaves when faced with a bad breakdown or extensive overhaul to be carried out as quickly as possible. The writer has had experience of a few under these conditions, and when it came to a case of personally carrying out an erection or repair job it was painful to watch their antics, even though in some cases they did possess the glory (?) of a B.Sc. degree. At home they have some chance, as they generally have skilled engineers under them or in touch with them on whom they can rely to pull them through. If the training schemes under discussion are to be the vogue in future, then the old war cry of "God save Britain from her enemies" will have to be changed to "God save Britain from her alleged engineers."

A Chief Engineer.

April 23rd, 1923.

Gas v. Electricity.

Your leader *re* "Helping Smoke Prevention," in your issue of April 20th, leaves in obscurity many facts that would answer the question "Why electrical men do not use electricity in their own homes."

You admit that anthracite, coke, gas and oil can be adapted for domestic use. Why "can be"? Is it not the case that at present fully 90 per cent. of domestic requirements have long ago been adapted for the purposes named?

Electricity, you say, "is effective, adaptable, and completely under control. It is clean, leaves no ash, and makes no smell. It does not escape and cause loss of life, &c." Gas can claim with authority all you state above.

If the Board of Trade returns of accidents and deaths be examined it will be found that according to their statistics gas is safer than electricity.

Again, you ask the question: "Why do not electrical men use electricity exclusively in their own homes?" and your answer is that: "Appliances and general equipment are too expensive." That is perfectly true, but it is only part of the truth, the real cause being that apart from the above, the cost at even 1½d. per unit makes its use prohibitive.

You instance what the gas people do in free and hire-purchase supply to consumers, and you suggest that the electrical undertakings should do the same. If they did so, what about the economic result? If 100,000 B.th.u. of gas be sold for 10d. per therm, and it takes, say, 29 units of electricity costing, say, 1½d. per unit, to give the same heat, then the advantage in favour of gas is the difference between 10d. and 3s. 7½d., apart from capital expenditure, &c., if apparatus were supplied free.

Until electricity can be produced without wasting under present best working conditions fully 80 per cent. of the coal consumed even electrical men will not use it for cooking and heating.

Wm. Baxter,
Member of Local Electrical Committee.

Leith, *April 21st*, 1923.

[Our correspondent in his bold advocacy of gas shows a confidence worthy of a better cause. He should be aware that the vast majority of private houses are heated not with anthracite or coke or gas, but with coal, which is also used for cooking in most cases—hence the smoke nuisance which was the subject of our leader. Having tried both gas and electricity for cooking and heating, we have no hesitation in stating that the latter is immensely superior to the former, whilst for lighting, of course, it is without a rival. We defy our correspondent to substantiate his statement that statistics show gas to be safer than electricity in domestic use (or in industrial use, though the latter case is external to the subject). We deny that the cost of electricity for cooking at 1½d. per kWh is prohibitive—or even at 2½d. For continuous heating we admit that electricity is too costly at present, but the same is true of gas; for occasional heating electricity is thoroughly satisfactory, and not unduly expensive. Our correspondent quotes again the fallacious comparison of thermal units supplied, ignoring the fact that with electricity they are almost wholly available, whereas with gas only a portion can be utilised; he can buy 100,000 B.th.u. of coal, so to speak, for 2d.—but how much of that can he *use*? According to his mode of argument, he ought to stick to coal!—Eds. Elec. Rev.]

Power Factor.

Thanks to the Electrical Review of 20th inst. I have just read your abstract of Mr. H. E. Yerbury's recent paper before the I.E.E. (Leeds). I believe that the author will not resent a few remarks from a southern enthusiast. The first point which I consider cannot be too frequently reiterated is: "It is obviously wrong to install power-factor improving plant at a generating station." But why is this so frequently done? Almost universally because a traction load has to be catered for and implies the installation of synchronous converting plant, probably rotary converters. Such an installation produces a tolerably good power factor at the station busbars, and so hoodwinks the responsible engineer into the belief that all is well, because the fact that his main a.c. distribution system, with its power factor of, say 0.4 to 0.7, is effectively camouflaged. And he goes on piling up his capital expenditure at the station on additional kVA sets and burying more copper in the streets. All interested supply men will join Mr. Yerbury in deploring the absence of "a simple instrument to integrate and record direct kVA" over a period.

That it is necessary to educate the consumer all will admit. I submit that it is vitally necessary to educate the supply engineer before the consumer, and that, with a few exceptions, the older school persist in keeping their eyes shut. Of late some very interesting facts have been published in the direction of a.c. motors having inherent good potentialities with regard to power factor, to the detriment, I trust, of the a.c. motor in its usually accepted terms. Lately certain gentlemen have asserted that So and So's make of motor will give a leading power factor at light load. Will some reader kindly explain how my ignorant self can prove simply that any particular motor before me is or can be working at a leading power factor? The paper which evokes this scribble advocates free advice to consumers on the part of the supply authority. Is there any authority extant to-day who is not prepared to advise if asked? But how many are asked?

With a few notable exceptions the take-it-or-leave-it attitude prevails. Standard kVA demand tariffs are conspicuous by their absence, and are difficult to apply even when an agreement on a kVA basis exists. Quite the majority of supply undertakings leave the consumers' power installation entirely in a contractor's hands, and of course, in view of competition, &c., the contractor often and usually puts in the cheapest and admittedly robust "common or garden" type of induction motor, quite regardless of the question of power factor, and the supply authority is practically powerless if a few turns of the handle of a megger do not disclose faulty insulation.

I believe the improvement of power factor will sooner or later have to come from efforts on the part of the supply authorities, backed up by legislation, a kVA-demand tariff, and an efficient power installation department. In conclusion I can only hope I have not herein trodden on any patentee's corns.

W. E. Rogers, A.M.I.E.E.

London, *April 22nd*, 1923.

High-power Ships' Radio Equipment.—The radio installation aboard the *Leviathan*, which is to re-enter the trans-Atlantic service in June flying the United States Lines flag, will be the most powerful and elaborate steamship radio equipment in the world. The contract has just been signed with the United States Shipping Board by the Radio Corporation of America, and the equipment will enable her passengers to exchange messages with two continents regardless of her position on the high seas, as uninterrupted communication with points 3,000 miles distant is to be assured.

In addition to telegraph service, a radio telephone installation which will provide voice contact with other vessels and shore stations is also to be installed. While it is not expected that a commercial telephone service will be inaugurated immediately upon the *Leviathan's* going into commission, it is quite probable that shore stations will in the not-distant future be erected to handle wireless telephone traffic from ships in mid ocean to points inland over the conventional land line system.

Apart from its commercial importance the protection of life at sea is the chief function of marine radio service, and a special emergency set will also be installed. Thus should one or two sets become inoperative due to a mishap, the third or emergency set may be relied upon to summon assistance. Furthermore, two of the life-boats are to be fitted with emergency radio apparatus. The principal transmitter will consist of a high-power vacuum-tube outfit which will deliver to main antenna about six times as much power as the apparatus now used on the average steamship. A rapid transfer switch will enable the operator to alter the wave-length of this transmitter in an instant. The second will be a duplex telephone outfit which will permit simultaneous telephone and continuous-wave telegraph communication. The third or emergency sending equipment will be a standard spark set which will normally operate on 600 metres. Several super-sensitive vacuum tube receivers will be used for reception.—*T. & T. Age.*

Silicious Earth Deposits in Skaane.—Great expectations are entertained regarding the production of insulating plates from the rich deposits of silicious earth at Djellasjoe in the vicinity of Oerkelljunga (Skaane). The deposits are specially valuable, as they contain about 20 per cent. of bituminous matter, which renders it possible to effect the direct pressing of the material into plates. The deposits are estimated at 800,000 cubic metres, which will suffice for the production of 1,000,000 square metres of plates annually for a long period. —*Reuter's Trade Service* (Stockholm).

NEW PATENTS APPLIED FOR, 1923.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sutton-Jones, O'Dell and Stephens, Patent Agents, 385, High Holborn, London, W.C. 1.

9,615. "Wireless receiving apparatus." A. Sharp. April 9th.
9,616. "Electric variable condensers." C. E. Raeburn and W. E. Taylor. April 9th.
9,618. "Sparking plugs." R. Bosch Akt. Ges. April 9th. (Germany, May 23rd, 1922.)
9,623. "Electro-deposition of metals." S. O. Cowper-Coles. April 9th.
9,628. "Electro-magnetic sound apparatus." B. A. Pilkington. April 9th.
9,639. "Inductance, &c., coils." W. Hunt. April 9th.
9,641. "Headpiece telephones." L. Dunwoodie. April 9th.
9,642. "Electric signalling apparatus." J. Crawford and E. McKillop. April 9th.
9,652. "Headphones." C. J. Coleman. April 9th.
9,658. "Sparking plugs." G. Lee. April 9th.
9,659. "Selecting switches." Western Electric Co., Ltd. (Western Electric Co., Inc.). April 9th.
9,664. "Protective systems for electric circuits." Metropolitan-Vickers Electrical Co., Ltd. April 9th. (United States, April 7th, 1922.)
9,665. "Dynamo-electric machines." J. A. Kuyser and Metropolitan-Vickers Electrical Co., Ltd. April 9th.
9,666. "Prevention of over-speeding of rotary elements." Metropolitan-Vickers Electrical Co., Ltd. April 9th. (United States, April 18th, 1922.)
9,667. "Electric power or distribution systems." Metropolitan-Vickers Electrical Co., Ltd. April 9th. (United States, April 11th, 1922.)
9,690. "Telephone receivers." R. C. Browne. April 9th. (United States, September 9th, 1922.)
9,695. "Systems for producing electric oscillations." British Thomson-Houston Co., Ltd. April 9th. (United States, April 10th, 1922.)
9,696. "Electric motor control." British Thomson-Houston Co., Ltd., and H. F. Farmer. April 9th.
9,698. "Means for connecting wires, &c., in electric circuits." W. A. Catherwood. April 9th.
9,731. "Aerials for wireless telephony, &c." P. C. Stevens. April 10th.
9,735. "Headpiece telephones." L. Dunwoodie. April 10th.
9,739. "Variable electric condenser." W. H. Hingston. April 10th.
9,740. "Electric plug switches." R. T. Waite. April 10th.
9,751. "Earphones or telephone receivers." C. L. Cuthbe. April 10th.
9,752. "Electric fuses." Holmes & James, Ltd., and H. E. Sutherland. April 10th.
9,753. "Cases for electric fuses, switches, &c." Holmes & James, Ltd., and H. E. Sutherland. April 10th.
9,762. "Coupling, &c., telephonic instruments." R. T. Wallace. April 10th.
9,780. "Wireless receiving apparatus." O. C. Morrison. April 10th.
9,781. "Binding posts or terminals for electrical apparatus." T. H. Brooker and L. E. Williams. April 10th.
9,782. "Loud speakers for wireless telephones." W. H. Johns and Johnson & Phillips, Ltd. April 10th.
9,783. "Variable electric condensers." Burndept, Ltd., and C. F. Phillips. April 10th.
9,784. "Dynamo-electric machines." Metropolitan-Vickers Electrical Co., Ltd. April 10th. (United States, April 11th, 1922.)
9,787. "Variable electric condensers." E. P. Liddell. April 10th.
9,794. "Electric lamps with coiled filament." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. April 10th. (Holland, April 27th, 1922.)
9,804. "Magneto electric machines." British Thomson-Houston Co., Ltd., and E. G. Parrott and A. P. Young. April 10th.
9,808. "Wireless signalling systems." British Thomson-Houston Co., Ltd. April 10th. (United States, April 10th, 1922.)
9,810. "Temperature controlling devices for electric heating appliances." B. R. Wingfield. April 10th.
9,815. "Conversion of kinetic energy contained in energy carrying fluids into electric energy." F. Hamer. April 11th.
9,816. "Tuning or resistance coil." L. Burgoyne. April 11th.
9,845. "Production of radioscopes, &c." M. de Marchi. April 11th.
9,847. "Electron discharge devices." N. Drey. April 11th.
9,858. "Amplification of electro-magnetic impulses." F. A. Hunter. April 11th.
9,860. "Radio receiving circuits." W. B. Medlam and C. H. Stave. April 11th.
9,862. "Electric switches." E. E. Bramall. April 11th.
9,867. "Telephone systems." J. E. Collyer and Coventry Automatic Telephones, Ltd. April 11th.
9,868. "Loud speakers for wireless telephony, &c." C. J. Coleman. April 11th.
9,869. "Electric signalling apparatus for railways, &c." R. Dell, L. H. Peter, and Westinghouse Brake and Saxby Signal Co., Ltd. April 11th.
9,885. "Telephone receivers, &c." British Thomson-Houston Co., Ltd., and A. P. Young. April 11th.
9,886. "Transmission of angular motion." British Thomson-Houston Co., Ltd. April 11th. (United States, June 16th, 1922.)
9,889. "Electric resistances." N. G. Langrish and Metropolitan-Vickers Electrical Co., Ltd. April 11th.
9,891. "Electric welding." Metropolitan-Vickers Electrical Co., Ltd. April 11th. (United States, April 11th, 1922.)
9,893. "Electric motors." M. W. Woods. April 11th.
9,899. "Electric terminals, &c." W. F. M. Edwards and W. M. Edwards. April 11th.
9,904. "Crystal cup and cover for wireless telegraphy." R. T. Wallace. April 11th.
9,905. "Electric heaters for liquids." W. Stubbs. April 11th.
9,910. "Wireless telephone receivers." E. A. Bradbury. April 11th.
9,954. "Electric circuit breakers, &c." B. H. Leeson and A. Reyrolle and Co., Ltd. April 12th.
9,959. "Automatic cut-outs for charging accumulators." C. C. Evans. April 12th.
9,974. "Series-parallel condenser switch arrangements." J. G. Lucas. April 12th.
9,979. "Means for series connections of electrical machines." Forges et Ateliers de Constructions Electriques de Jeumont. April 12th. (France, December 27th, 1922.)
9,982. "Device for prevention of access to electric switches of motor-cars." C. G. Riddell. April 12th.
9,988. "Wireless detectors or amplifiers." S. L. Price. April 12th.
10,000. "Electric current collecting brush devices." Metropolitan-Vickers Electrical Co., Ltd. April 12th. (United States, April 13th, 1922.)
10,012. "Holder for telephone headpiece." L. E. Richards. April 12th.
10,014. "Wireless receiving apparatus." G. Stephenson. April 12th.
10,026. "Electric motor control." R. S. Allen. April 12th.
10,040. "X-ray apparatus." W. H. Coleman. April 13th.
10,069. "Aerials, &c., for wireless apparatus." W. G. Walter. April 13th.
10,072. "Gravity electrical piston gas valves." R. MacLaren. April 13th.
10,075. "Wireless crystal rectifiers." C. J. Coleman. April 13th.
10,076. "Horns for gramophones, &c." C. J. Coleman. April 13th.
10,082. "Continuous-current dynamo-electric machines." M. W. W. Mackie. April 13th.
10,083. "Wireless detector." A. W. Fisher. April 13th.
10,093. "Electric terminal." A. Rothschild. April 13th.
10,095. "Electric switch." G. Marr. April 13th.
10,096. "Loud speakers for telephony, &c." Engineers (Penge), Ltd., and S. A. Huss. April 13th.
10,097. "Securing electric light shades." H. J. Carter. April 13th.
10,098. "Control of trains." A. R. Angus. April 13th.
10,103. "Wireless transmitters." Ges. für Drahtlose Telegraphie. April 13th. (Germany, April 13th, 1922.)
10,104. "Inductance coils." A. Phillips. April 13th.
10,106. "Cable telegraphy." S. G. Brown. April 13th.
10,112. "Loud speakers for wireless telephony." W. H. Johns. April 13th.
10,113. "Loud speakers for wireless telephony." W. H. Johns. April 13th.
10,117. "Telephone receivers, &c." British Thomson-Houston Co., Ltd., J. H. Butcher, and A. P. Young. April 13th.
10,121. "Electric resistances and switches." H. A. Gaydon. April 13th.
10,122. "Support for aerials, &c." A. C. Greene. April 13th.
10,123. "Support for aerials, &c." A. C. Greene. April 13th.
10,125. "Electric governing of water turbines, &c." F. S. Smythe. April 13th.
10,129. "Electric current generators." H. W. F. Ireland and J. Lucas, Ltd. April 13th.
10,135. "Apparatus for controlling vehicles driven by electric motors." Akt. Ges. Brown, Boveri et Cie. April 13th. (Germany, June 6th, 1922.)
10,136. "Variable electric condensers." W. Dubilier. April 13th. (United States, September 16th, 1922.)

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1921.

28,242. "Single-layer winding for alternating-current generators." Akt. Ges. Brown, Boveri et Cie. October 28th, 1920. (170,850.)
28,667. "X-ray apparatus." M. A. Codd and X-Rays, Ltd. October 28th, 1921. (195,416.)
31,502. "Alternating-current dynamo-electric machines." F. Contell. November 24th, 1921. (195,433.)
31,510. "Electro-magnetic relay." Western Electric Co., Ltd. (Western Electric Co., Inc.). November 24th, 1921. (195,424.)
32,019. "Means for, and methods of reducing capacity current losses in electric cables." A. M. Taylor. November 30th, 1921. (195,429.)
32,422. "Electric motor control systems." A. H. Jackson. December 3rd, 1921. (195,431.)
34,535. "Automatic telephone exchange system." H. Baron (F. Alendorff). December 22nd, 1921. (Cognate application, 5,924/22.) (195,439.)
34,672. "Electron discharge apparatus." General Electric Co., Ltd., and B. S. Gossling. December 23rd, 1921. (195,440.)
34,868. "Electric trolley poles." G. W. Ferguson. May 18th, 1921. (180,294.)
34,905. "Electrically-controlled counting apparatus for use in totalisators and the like." G. H. Wallace. December 29th, 1921. (195,447.)
34,982. "Electric holder for electric arc generators for the production of high-frequency electric waves." H. Sefton-Jones (C. Lorenz Akt. Ges.). December 29th, 1921. (195,453.)
35,037. "Automatic and semi-automatic telephone exchange systems." Siemens Bros. & Co., Ltd., and H. E. Humphries. December 30th, 1921. (195,455.)
35,057. "Electrical selective calling devices." Soc. Française Radio Electrique. March 22nd, 1921. (177,488.)

1922.

131. "Electrical apparatus particularly applicable to wireless sets." C. W. C. Beckman and P. Alexander. January 3rd, 1922. (195,461.)
912. "Couplers for the train lines or conductors of electric railway vehicles." W. T. Gray and Metropolitan-Vickers Electrical Co., Ltd. January 11th, 1922. (195,468.)
1,151. "Electric steam generators." L. G. de Kermor. January 13th, 1922. (195,470.)
1,504. "Electric candle lamps." O. T. Banks. January 17th, 1922. (195,472.)
1,864. "Electric accumulators." H. Leitner. January 21st, 1922. (Cognate applications 2,952/22 and 4,304/22.) (195,477.)
2,355. "Electric connectors." G. H. Collins and H. F. Collins. January 26th, 1922. (195,484.)
2,762. "Voltage regulator for electric alternating circuits." Johnson and Phillips, Ltd., and H. M. Lacey. January 30th, 1922. (195,487.)
2,997. "Electrical regulating switches." F. C. Curtis. February 1st, 1922. (195,490.)
3,413. "Manufacture of electric cables." Callender's Cable and Construction Co., Ltd., and P. V. Hunter. February 6th, 1922. (195,494.)
3,457. "Interrupters for electric circuits." Metropolitan-Vickers Electrical Co., Ltd. April 25th, 1921. (179,141.)
4,319. "Electrical networks." Western Electric Co., Ltd. (Western Electric Co., Inc.). February 14th, 1922. (195,496.)
4,640. "Submerged electro-plating, shaking, scouring, and similar barrels." F. R. Tubbs and F. V. Breeden. February 16th, 1922. (195,498.)
5,238. "Device for automatically substituting one source of light for another, particularly in connection with lighthouses." Anciens Etablissements Barbier, Bénard et Turenne, Soc. Anon. May 21st, 1921. (180,632.)
6,436. "Electrical hot-air stove." G. Comboni. March 4th, 1922. (195,506.)
6,856. "Methods of making silica or quartz glass." British Thomson-Houston Co., Ltd. (General Electric Co.). March 8th, 1922. (195,508.)
8,554. "Terminal electrical connections." M. L. Williams. March 24th, 1922. (Addition to 151,349.) (195,521.)
9,876. "Electric mincer." H. E. Holman. April 6th, 1922. (195,524.)
10,932. "Apparatus for automatically operating electric switches." W. Frisby. April 19th, 1922. (195,533.)
11,582. "Sparking plugs." R. S. Woodruff. July 7th, 1922. (195,538.)
12,624. "Riveted joints for connecting a plurality of electrical conductors together in electrical contact to a common insulator." Scintilla (Firm of). May 4th, 1921. (179,547.)
13,048. "Thermionic valve circuits." N. F. S. Hecht. May 9th, 1922. (195,546.)
16,677. "Anti-vibration fittings for electric lamps and other articles." Veritys, Ltd., and F. W. Thorpe, June 16th, 1922. (195,555.)
16,702. "Safety devices for use with electrical apparatus." Norwest Electrical Manufacturing Co., Ltd., and A. J. Penman. June 16th, 1922. (195,557.)
17,159. "Electrolytic process of recovering zinc from complex ores." J. T. Ellsworth. July 12th, 1921. (183,117.)
19,916. "Electrical advertising, signalling, and displaying apparatus." C. T. Marks, S. G. Higgins, and A. E. Foxlee. July 20th, 1922. (195,564.)
24,998. "Manufacture of grid resistances." L. Satchwell. December 16th, 1921. (Cognate application, 6,467/22.) (Divided application on 191,934.) (195,653.)
28,223. "Incandescent electric lamps." T. G. Thomson and A. Smith. October 17th, 1922. (195,573.)

1923.

4,388. "Telautography or photo-telegraphy." H. G. Bartholomew and M. L. D. McFarlane. September 19th, 1921. (Divided application on 24,825/21.) (Cognate application, 4,389/23.) (A divided application on 3,982/22.) (195,577.)